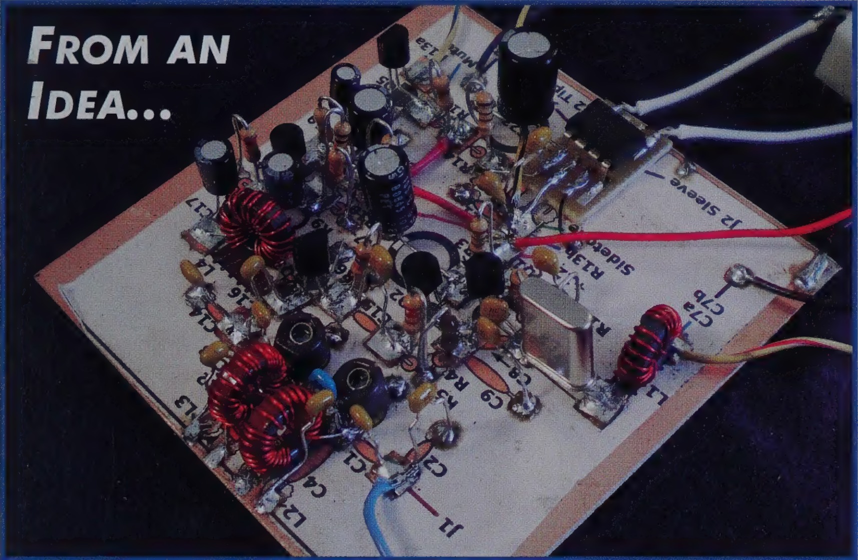
Your Construction and Operating QRP Sourcebook

Volume 50 Number 4
Fall 2009
$4.95

QRP Quarterly

Journal of the QRP Amateur Radio Club International



(Read the Whole Story on Page 22)

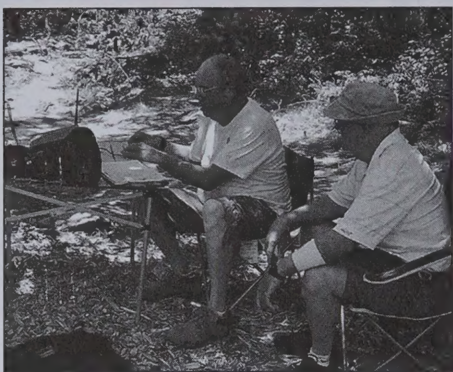
- More Great Homebrewing Info in WA8MCQ's *Idea Exchange* Column
- QRP Hilltopping with W1PID and K1JAW
- Build a WWII Paraset Replica with AE4IC
- W8DIZ Begins a Frequency Counter Project
- Contest Results—
  2009 Hootowl Sprint
  2009 milliWatt Field Day
  2009 Summer Homebrew Sprint
  2008 Contest Championship Official Results!

QRP ARCI℠ is a non-profit organization dedicated to increasing worldwide enjoyment of radio operation, experimentation and the formation and promotion of QRP clubs throughout the world.

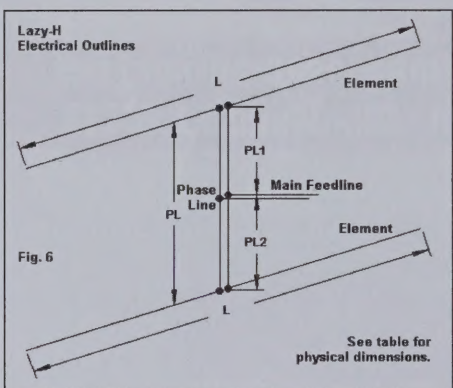
Table of Contents

QRP Quarterly

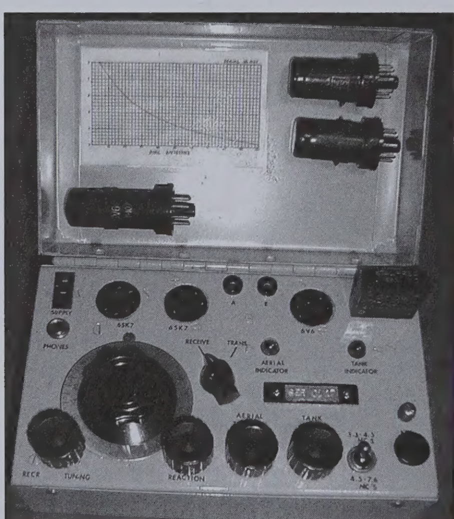
Volume 50 Number 4 – Fall 2009



page 27



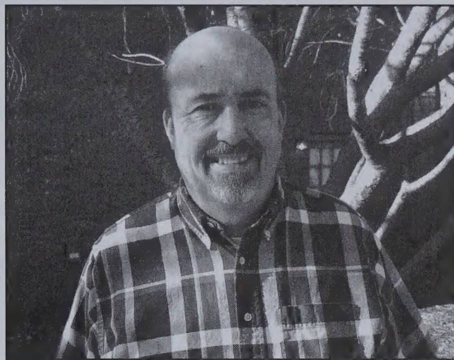
page 30



page 42

From the President

Ken Evans—W4DU president@qrparci.org



First, I want to welcome our new editor, Brian Murrey, KB9BVN, to the staff. Brian comes to us as an enthusiastic QRPer and with editorial experience as a past editor of "Bacon Bits" (Flying Pigs QRP Club Newsletter). Those of you familiar with Bacon Bits will know it is an excellent publication. Please join me in welcoming him and provide him all assistance needed.

Fall is in the air here in Georgia. The nights are cooling off and we are starting to see some evidence of leaves beginning to turn. I have also noticed that the noise levels on the bands are starting to drop. 160 and 80 meters can be buzz saws during the Georgia summers, but in the last few days, I have had the surprise of getting on 80 to find it somewhat quiet on both noise and signals!! To increase activity and promote QRP, some of the local QRP clubs are hosting nets on 80. One example is the Four State QRP Group (http://www.4sqrp.com/). They are hosting an 80 meter CW net on Wednesday evening. All hams are invited to check in. The net starts at 8:00 PM Central time on 3562.5 kHz + or – QRM. Also, the North Georgia QRP Club (http://www.nogaqrp.org/) has a similar net at 9:00PM Eastern time on Tuesday nights on or about 3560 kHz. Links to many clubs are found on the QRP ARCI web site (http://www.qrparci.org/). Check them out and you'll find a number with on the air activities on a number of bands including 80.

Fall also brings on a number of QRP contests. QRP ARCI is sponsoring the Fall QSO Party on October 17 - 18, the Top Band Sprint on December 3, 2009; and the Holiday Spirits Homebrew Sprint on December 20, 2009. Details are at the QRP ARCI site. Also, the exchange of membership numbers during these contests can be used for credit in the Worked All ARCI Challenge. I hope to work some of you on the bands.

In last month's column I said that the club would be making an effort in advancing QRP's role in amateur radio. There are many ways to do this, but this month I want to focus on two specific areas. The first thing all of us can do is simply get on the air. Jumping into the nets and contests mentioned is one way to garner interest. Hams that are not QRPers may hear the activity and perhaps jump in and get interested. I had a recent QSO where I was asked three times to repeat my power (750 mW). The other ham gave me a 579, so he heard me but didn't trust that he copied correctly. I guess it took the third time for the "milli" to convince him! A single QSO from us can demonstrate to others the possibilities of QRP.

The second thing the club can do is to be visible to the amateur public. The club officers are making an effort to increase the QRP ARCI presence at hamfests. We had a club table and hosted a forum at the Huntsville Hamfest this past August. Many stopped by the table and a number attended the forum. We signed up 18 new members and two others renewed. We will have a QRP table at Pacificon this year, Hank Kohl, K8DD, a QRP ARCI Board Member will be the representative. Plans are underway for the club to be at the Stone Mountain Hamfest (GA), the GQRP Convention (UK); the Orlando Hamcation (FL); and Ham-Com (TX). A club officer will be present at each of these events to speak "officially" for the club. My current plans include the GQRP convention and Ham-Com. We have found that our physical presence helps to fully answer questions and plant some seeds of interest. Every time we go to a hamfest we always sign up new members. If there is a hamfest in your area that you feel would benefit by having a QRP ARCI table, please let us know. The club has set aside resources to

(continued on next page)

enable us to attend and promote QRP at hamfests. We will not be able to make them all, but we will get to more this year than we did last year.

This is my second time to write a "From the President" column. After proofreading my own words, I am realizing why this column may be read intermittently by the membership! The meat of the magazine and the focus of your interests are the articles from regular columnists and other authors. However it is important that you hear from the club officers via the President. So if there is anything that you would like me to include in this column, let me know and I'll do my best to cover it. In the mean time, if you work someone that is new to QRP, encourage them to give it a try. You can also sign them up as a member of the club! I hope to bump into some of you on the air in the next few months. We may even meet at a hamfest.

72, Ken, W4DU
QRP Future

●●

QRP News

Correction to Summer 2009 *QRP Quarterly*

Class E Power Amplifiers for QRP-David Cripe-NMØS—Page 32

Sirs: I wish to thank you for re-printing my FDIM presentation, "Class-E Power Amplifiers for QRP." However, an important omission occurred during the publication, that being the "square root" function (superscript 0.5) was lost for the equations for C3, C5 and L3. There was also an extra R term in the denominator of the L3 equation.

The correct equations should be:

C3 = C5 = 1 / (2 * pi *F * (R * 50) ^ 0.5)

and

L3 = 0.75 * (R * 50) ^ 0.5 / (2 * pi * F)

Please make note of these corrections in an upcoming issue.

Thank you

—73, David Cripe NMØS

Worked All ARCI Challenge—
August 1 to December 31, 2009

Are you making progress in the WAA Challenge? Don't know what it is? Well, it's simply working/collecting as many "ARCI" numbers before the end of the year. Enter a contest, check into a net, call CQ-ARCI on 7.030/7.040, and get those "arci" numbers. Check the website: http://www.qrparci.org/waac

It's very simple, just work as many different QRP ARCI members, send in your "log sample" before Jan. 31, 2010 and you could win some nice prizes! Here is a way to concentrate your effort and find other ARCI members. We've worked with Andy, K3UK, to set up a scheduling page on his very useful site. Just check in there often and ask for other ARCI members to work you on schedule. The site is:

http://www.obriensweb.com/sked/index.html

You'll see us squeezed in there with our friends from FISTS so why not give them a number if you have one at the same time you trade ARCI numbers. To focus our efforts, why not look there right after (or even during) the FOX HUNTS each week (be sure to NOT post the FOX frequency as that's not hoyle!) So at 10:30 Eastern U.S. time (Tue/Thur), check the K3UK site for other members and trade numbers. After Jan. 1, 2010, send your entry to W4QO at his QRZ address (no one uses CBA—Call Book Address anymore, do they?)

As info, in the early days of QRP ARCI, the *QRP Quarterly* (at that time just a few mimeographed sheets) was taken up with pages full of members and how many others they had traded QRP ARCI numbers with. Let's bring back the exchange of QRP ARCI numbers with our QRP friends. In a related vein, your club has offered for years the Worked All ARCI award. The award is available for working 50, 100, 200, 400, 800, and 1600 ARCI members. We highly encourage you to think in terms of achieving the Worked All ARCI Award.

Who will win the first Worked All ARCI Challenge? It could be you!

—de Jim/W4QO

New Editor Seeks Articles—Try Writing for *QQ*!

QRP club activities, portable operating, antennas, kit building and "from scratch" homebrewing... These are only a few of the interesting things that QRPers do for fun and personal satisfaction. If *you* think they are interesting, so do many of your QRP colleagues around the world, so consider writing about your contribution to the QRP part of ham radio. Large or small, there is place for it in *QRP Quarterly*!

Send ideas for articles to Editor Brian, KB9BVN or to one of the Associate Editors. E-mail and mail information is in the Staff listing on page 3. We will decide how to proceed—and will help get your story prepared if you don't have much writing or publishing experience.

And don't forget that even small things are needed. Mike C, WA8MCQ would love to see your hinks 'n kinks notes for the "Idea Exchange"; Bob, KØNR wants to hear about your VHF/UHF QRP activity; and Tim, WB9NLZ will be delighted to present your local QRP club's latest happenings in his "QRP Clubhouse" column.

So gather a few photos and drawings, write a few notes and let us know what you've done! ●●

Idea Exchange

Technical Tidbits for the QRPer

Mike Czuhajewsi—WA8MCQ wa8mcq@verizon.net

In this edition of the Idea Exchange:

USB Battery Extender

Continuing the endless series of Technical Quickies that he promised me back in 1991 or so, Joe Everhart, N2CX, presents installment #71—

Several recent Quickies have described USB power sources separate from computers to provide a nominal 5 V power. The output can be used to power either your circuitry of choice or to supply power to or charge batteries in a "real" USB device. Quickie #61 (Ref 1) described simply ways of using components mainly bought from a dollar store to make 4.5 or 4.8 V power sources employing only three alkaline or four NiMH AA cells respectively. Quickie #66 (Ref 2) showed some inexpensive commercial power sources for 12 or 5 V, the latter having built-in USB jacks. This Quickie is a follow-up featuring another option.

Several "battery extenders" are on the market that allow use of common AA cells to recharge consumer electronic devices such as cell phones and MP3 players. They can also be used to provide 5 V power to any device that will plug into a USB jack. One simple power source was described in Quickie #66. Its total output power is limited, though, since it uses a single AA cell along with some circuitry to boost the output to about 5 V. Other commercial devices use two AA cells and some electronics for more total power. Additionally, homebrew versions are described on the web (Ref. 3).

I was recently able to also see the "guts" of another "battery extender" that used four AA cells. It was a quick look so there was no time to take photos. Unlike the supplies in Quickie #61 it supplied a full 5+ volt output and used alkaline cells. Perhaps others use more sophisticated circuits, but this one used only a series 1N4001 diode to bring the 6V battery level down to about 5.3V under load.

Strictly speaking the power supplied by USB ports should be 5 V ±0.25 V, so the measured 5.3 V value is slightly high, although not excessively. Full spec USB port supplied power is also current limited to 100 mA for USB1 and 500 mA for USB2. And for completeness there is some handshaking involved with USB ports to fall back to 100 mA unless the device connected indicates that it is USB2 compatible. You can find lots of info on this by doing a web search. However if a little care is taken, the simple circuit described above will meet most casual uses.

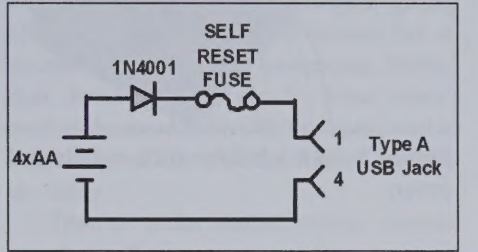


Figure 1—5V USB source circuit diagram.

One very important option is to provide some current limiting. Figure 1 shows the configuration I recommend. Quite simply, a positive temperature coefficient (PTC) self-resetting fuse with a trip point of 1 to 2 amps is added. Mail order distributors such as DigiKey, Mouser and Jameco carry them for under a dollar apiece, although many hamfest parts dealers offer a bag of them for a dollar. Be sure that you pick one intended for 6 to 10 volts use since those intended for higher voltages have an unacceptably high series resistance. If you are going to use the device to provide up to 500 mA, series diode D1 should be a 1N4001 or similar. For loads under 100 mA a shortcut method is to use a low current diode such as a 1N914, 1N4145 or 1N4148 and possibly not use the fuse. The latter method relies on the diode to self-destruct in event of a high overcurrent condition to minimize damage.

For flexibility and economy I prefer to use a USB jack on a cable rather than a case-mounted jack. Quickie 61 described doing this by modifying a dollar store USB cable. Several feet in length, the cable has a jack (male) type A USB connector on one and a

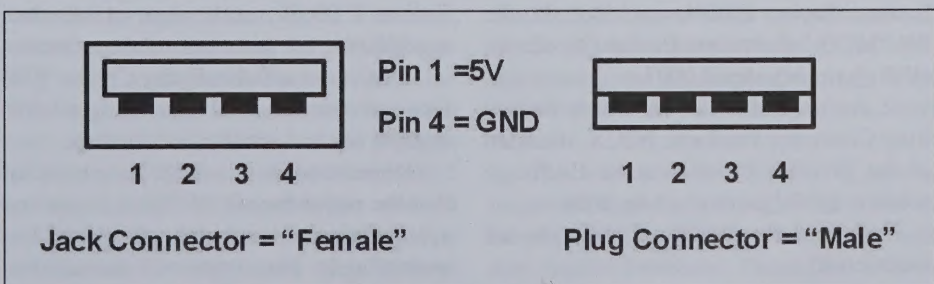


Figure 2—USB connector power pins.

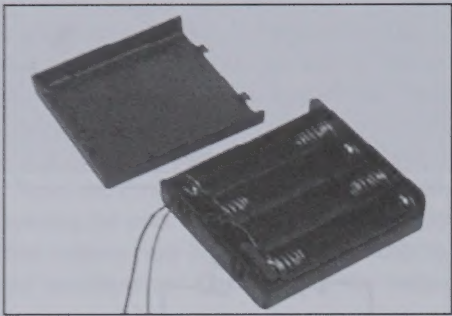


Figure 3—4 AA holder with switch and cover.

plug (female) type A USB connector on the other end. Simply cut the cable in half using the jack end and save the plug end for another project. To connect an external device using a mini or micro USB connector simply use an adapter cable. Figure 2 describes the correct connections for both plug and jack type A USB connectors.

A variety of 4-AA cell holders are available from the usual vendors. I prefer the kind with a cover and on-off switch, though an open one will work as well. If you chose the right holder, you may find enough room to mount the diode and fuse inside. If mounted externally they should be mounted to provide electrical insulation and strain relief for the external cabling. A typical holder is shown in Figure 3.

Remember to keep safety in mind. Carefully observe diode and cable polarity, and double check everything with an ohmmeter and voltmeter. If you intend to use the supply to power a true USB powered device be sure to test first on an expendable one—I have a cheap USB stick MP3 player as my test unit. If you are cautious all should work fine; ultimately, you are responsible for any damage that might be caused by misapplication of the power source.

References:

1. Joe's Quickie No. 61: Cheap "5V" Battery Packs, N2CX, included in the WA8MCQ Information Exchange column, *QRP Quarterly*, April 2007

2. Joe's Quickie No. 66: Power Bounty from Consumer Products, N2CX, included in the WA8MCQ Information Exchange column, *QRP Quarterly*, July 2008

3. http://ladyada.net/make/mintyboost/index.html

—de N2CX

A Good Old VFO

Rick Campbell, KK7B, posted these thoughts to the EMRFD discussion forum on yahoogroups.com recently, about older technology—

For several critical receiver applications in my lab I've used old Collins PTOs (permeability tuned oscillators) converted to solid state. I just replace the triode in the classic Hartley circuit with a J310 field effect transistor and run the circuit from a 9 volt regulator. I have half a dozen of them in dedicated propagation study receivers, and one SSB exciter I occasionally use on UHF.

The other day I was changing something else in one of my receivers and connected the solid-state PTO to the frequency counter on my bench. The PTO was set to 3.100000 MHz. From a cold start (it hadn't been turned on for years) it drifted three Hz over the first ten minutes, and then a total of 10 Hz over the next few hours. When I calibrated one of my 144 MHz propagation study receivers 25 years ago, total frequency drift was <18 Hz/hour. I expect most of that was aging of the overtone crystal oscillator in the premix circuit.

Old Collins PTOs are common (someone at Dayton this year had a box of unknown ones in decent shape for $10 each, and there are R390 PTOs in the current Fair Radio flyer). I've never had one fail, tuning resolution is infinite, phase noise is low, digital noise is zero, and once I build one into a receiver, that part of the project is done—no improvements or software upgrades needed.

My research receivers are connected to a baseband Fourier analyzer (yes...even 25 years ago). The finest resolution I've used for serious experiments is 10 milliHertz, but more often I use 1 Hz resolution, with 1024 channels in the output spectrum. I often average spectra for more than a minute, so frequency drift needs to be less than 1 Hz per minute. The solid-state Collins PTO is much more stable than needed even for those critical experiments.

This is not a fluke. Every Collins PTO I've converted to solid state using a U310 or J310 has had similar performance.

Sometimes it is useful to remember that the major benefit of digital frequency synthesis is that it is quick, cheap, and frequency agile. No commercial manufacturer could afford to build a transceiver with a Collins Mil-Spec PTO in it these days. But for an amateur with mechanical skills or access to surplus hardware who needs just one good oscillator, the venerable Hartley with a temperature compensated tuned circuit and a JFET can provide outstanding performance.

In music, art, architecture, automobiles, motorcycles, etc., there are recognized "golden eras" where some combination of factors resulted in technical hardware that is widely recognized as being superior to what is being produced today. Often the difference is directly related to the amount of skilled labor needed during production. As technical hobbyists, we automatically assume that new is better, but as experimenters, we should be open to the idea that sometimes the technology, ideas, and block diagrams of an earlier era are superior to the cost-driven disposable technology coming off fully automatic assembly lines in some out-of-the-way place with inexpensive labor and attractive business tax codes.

The idea that old technology designed decades ago by retired guys might be better than new technology is a radical concept in electronics. But NASA is using a brand new, hand built, Traveling Wave vacuum tube in the current Moon exploration mission. After 100 years of radio experiments—it is fun to look back and find old technology that might actually work better than some of the new things we've been inventing recently.

—de KK7B

Electric Fence Insulators for Antennas

This was sent along by Daniel Boone, WD4DB.

I'm always on the lookout for simple, cheap things to use for building portable antennas. My latest find might be "old hat" but I thought I would share it with you.

Figure 4—Insulators for electric fences make inexpensive antenna insulators.

Browsing through my local hardware store I came across what has to be the cheapest substitute for miniature strain, or plastic "dog bone" insulators. They are the corner insulators for electric fences. Figure 4 shows the package and a couple of insulators. They are usually sold in bags of 10 or 12 for around $2. The ones I picked up have built in "clips" in one groove so you can oversize the wire loop and the antenna wire won't fall out, allowing you to replace the insulator if/when you step on it in the dark.

Not all are bright yellow; I have seen many along fence rows that were black. They would be better to hide that stealth antenna from the neighbors. I choose the brighter ones only to help keep from stepping on them as I tear down the portable antenna in the dark!

—de WD4DB

NE602 Lives On Under a Different Name

If someone ever comes up with a universal QRP FAQ somewhere this topic will probably be one of the first ones to be covered. Within the last several months I saw people on two different online discussion forums lament the fact that the NE602 double balanced mixer chip is used in so many designs but no longer available. This seems to come up every couple of years and the title above says it all. Yes, the NE602 is long gone and people sometimes try to charge hefty sums for them since they are unavailable. But you don't have to buy those unless there is some reason why you absolutely, positively must have a part marked with that specific number on the outside. You can get parts with exactly the same thing on the inside but with different numbers.

The part itself is still available and at reasonable prices. Both Mouser and Digi-Key stock them in both the SOIC surface mount and through-hole DIP packages for a couple of dollars or less. The numbers are SA602 and SA612, but the current manufacturer name may not be familiar. You may remember these as coming from Philips or Signetics before that, but they are now made by NXP Semiconductor, a recent spinoff from Philips. (They are currently made in a different location than indicated below, which was based on 2002 information.)

Earlier in the decade Paul Harden, NA5N, made several posts to the QRP-L and GQRP-L online forums on the topic. I wrote up a compilation of those, let him review it to be sure I got everything right and ran it in the July 2002 issue of the QRP Quarterly. Since it's been many years it's time to run it again for the newcomers. Some of the info will be outdated; the numbers listed above are those that are currently available. Here's what Paul had to say about it—

The NE602 is in fact obsolete, and has been for years. It was the original IC mixer designed and produced by Signetics, a company now long gone. The NE602 is obsolete by number designation only, but still alive and well and available as the NE612 or SA612. (The NE612 is the plastic IC version and therefore cheaper than the ceramic SA612. The NE612AN indicates the thru-hole version.) *[There is no longer a ceramic version in 2009.—MCQ]*

The ever-famous chips are manufactured in the Philips Semiconductor plant in Albuquerque, about 85 miles north of me. I visited there and had a nice discussion with an applications engineer about the history of the NE602s. They were quite shocked to learn of the widespread usage of NE602/NE612s by hams/QRPers, a market for these mixer chips they were unaware of. They claim there are no immediate plans to discontinue making the NE612s. They do tend to wait until the worldwide stock gets very low before making more, as they don't like to tool up for an IC without making several tens of thousands at a time. This long story will prove that NE602 = SA602 = NE612 = SA612.

The original NE602 was designed and manufactured by Signetics for the 45 MHz FM wireless telephone market. A little later, the wafer was redesigned a bit to allow the internal oscillator to operate to 200 MHz and the RF to 500 MHz. This was redesignated the NE612, and was intended to replace the NE602. However, customers kept ordering the NE602, getting angry at Signetics because their distributors were out of stock, etc. So when they made the chips, they made a jillion NE612s, and labeled some of them NE612 and the rest NE602 to satisfy the users of both parts. This is why contemporary data books show the exact same specifications for both NE602 and NE612. They came from the same wafer.

Signetics was bought out by Philips, who evidently continued this practice for a short time, then decided it was rather redundant. They announced that the production of NE602s had been discontinued and listed it as an obsolete part, giving QRPers around the world various fits of apoplexy and suicidal tendencies, feeling that doomsday had struck. What wasn't well understood is that Philips continued to support production of the NE612, as they do today.

Then to make matters worse, disaster struck the Philips plant in Albuquerque in the spring of 2000. A wild grass fire in northwest New Mexico threatened three main electrical lines that run from the "Four Corners" electrical generating plant to Albuquerque. Smoke from the fire caused one of the high-voltage lines to arc, tripping the circuit offline. Virtually the entire electrical load for Albuquerque and southern New Mexico was now transferred to the two remaining feeders, which could not handle the full load, causing brownouts, voltage spikes, etc. until they, too, failed.

Where I live in Socorro, New Mexico, I remember the brownouts hit about 4:15 PM, outages on and off until the entire grid went down about 5 PM, and stayed off until about 11 PM. It was one of the longest power failures in US history. We just figured it was Y2K about 3 months late. (PS: I worked 40M CW QRP that night by candlelight, and it was the quietest conditions I ever heard on 40M!!! And every QSO I heard seemed to be a QRPer.)

The extreme voltage fluctuations as the feeders were failing caused a transformer at the Philips plant in Albuquerque to catch on fire. I remember seeing it on the TV news, in which they said it caused mostly smoke damage from the burning transformer and burned a couple of storage rooms. At first the damage was considered to be minor. However, it was soon learned that the smoke and water contaminated all of the IC fabrication "clean rooms" and equipment, and caused heat damage to the room where the IC film masters were stored.

This means some of the very touchy negatives used for making the dies had to be redone. The NE612 film master was now molten emulsion. These film masters were the originals from the old Signetics company. And all of the clean rooms and

die-making machinery had to be cleaned and refurbished to ensure that no contamination would occur in the IC fabrication process.

Philips had to completely redo the artwork for the majority of their ICs. They were basically unable to manufacture ICs at the Albuquerque plant for months. It was about 8 months before they got all their wafer machines back on line, which left a huge hole in the semiconductor industry. I know it just about killed several cell phone manufacturers because delivery contracts for parts were suddenly postponed for six to eight months.

The first production to get back on line was the larger scale 20 mm dies (for the large multi-pin ICs used in cell phones, etc.), then the 10 mm, and finally the 5 mm die production (which the NE/SA 602/612s fall under) became operational in late July. Philips Semiconductor announced that the Albuquerque plant was again 100% operational and running at 100% capacity.

According to an article in early August in the "Albuquerque Journal," Philips was running at 100% capacity before the fire, followed by many months of limited capacity following it. So now that they were at full IC production again, they were woefully behind in their production schedules, for which some of their ICs will end up being manufactured over a year late. The world supply of SA612ANs (the thru-hole version) was nearly exhausted at their distributors in the fall of 1999, producing a known shortage, and they were not due for production until September 2000.

[At that time, the SA612 was essentially the same as the NE612 but with a wider temperature range.—WA8MCQ]

The worldwide supply of NE602/NE612s virtually dried up during 2000 as a result of this fire and the nearly year backlog of manufacturing quotas. The first run of NE612s in 2 years finally occurred in September 2000. This huge shortage of NE612s, combined with the fact that NE602s have been discontinued/obsolete, is what convinced QRPers that these nifty little chips were no more. I was told that 20,000 units were manufactured in 2000, or what Philips believes is a 2 year supply. This is also why the release of the Elecraft K1 (with 5 NE612s!) was delayed from the promised "after Dayton" to late in the year, as were other kits. It just wasn't clear when Philips was going to schedule the NE612s for production.

So yes, the NE602 is dead, but the perfectly compatible NE612 and SA612 are still available, and Philips has no plans at the present to discontinue them.

For final clarification:

NE602 = plastic DIP, rated 0ºC to +70ºC ... OBSOLETE
SA602 = plastic DIP, rated –40ºC to +85ºC ... OBSOLETE
NE612 = plastic DIP, rated 0ºC to +70ºC ... AVAILABLE
SA612 = plastic DIP, rated –40ºC to +85ºC ... AVAILABLE

For our QRP purposes, the NE612 is EXACTLY the same as the NE602. NE612s are still being made, still available from most vendors, is not obsolete, and should be available for several years yet to come. If a vendor tells you the NE602 is obsolete, then have him check on the NE612. If he claims those are obsolete also, it just means they do not carry them.

—de NA5N

WA8MCQ comments: Keep in mind that all of the info above was written 7 and more years ago. What are currently available are the SA602 and SA612, now made by NXP Semiconductors. Both are available in either 8 pin SOIC surface mount packages or the familiar 8 pin DIP package, and all are plastic. (They are not available in ceramic.) Both are rated at –40C to +85C.

The data sheets for both can be downloaded from the NXP web site, www.nxp.com. They are available in PDF format and still have the Philips name on them, dated 1997. I didn't see any real difference between the two so it would appear they are still keeping the 602 number alive as Paul said, with the two parts being identical except for the markings. Both are stocked in both packages by Mouser and Digi-Key. (Mouser has the lower price, especially for the SOIC version.)

In case anyone is thinking about driving to Albuquerque to see the plant, don't bother. NA5N told me recently that it was closed 2 or 3 years ago and the production is being done elsewhere.

Again, the bottom line is that the NE602 continues to be available under a different number.

—de WA8MCQ

Iambic Paddle Made from Two Code Practice Keys

Don't throw away those old code practice keys. Barry L. Ives, AI2T, describes how he turned a pair of them into an iambic paddle—

I always like to look for bargains in the thrift stores. I have found old two-way radios, lots of electrical stuff, wire, metal boxes to build things into—you get the idea. Imagine my thrill when I found two old CALRAD code practice keys, the buzzer type, as good as new, still in the boxes, for $6.99 each! I'm not sure why my wife had to talk me into buying them—I guess I am just a miser! Anyway, they wound up on a shelf for months, as I wondered what I could use them for, since I already have a nice straight key.

Don't get me wrong, these CALRAD keys are top of the line, made in Japan, about the 1960s, with machined steel parts, metal strips connecting the various electrical points, screw terminals, and heavy plastic bases. I hated to take apart such nice specimens, but I had a better use for them. I have since learned there were several different brands of these on the market during that period, so maybe you can find a couple if you want to try this yourself. In my experience, the buzzers on this kind of key never did work very well!

You see, I would find it hard to shell out $70 to $300 for a paddle key to use with my rig's internal keyer. So I just carried on with my old Heathkit Micromatic Keyer, with its RF intolerance and birdies here and there on the bands. That is, until it dawned on me that those two code practice keys placed back-to-back would make a nice iambic paddle—if I could get them mounted just right. I am far from being the mechanical type—I generally deal with numbers and theory. So it took me a while to get around to taking a close look at these keys to see if there was a way to make my idea work.

I decided to use the side of an old wooden cigar box for the vertical mounting surface. Turned out not to be a bad choice, but I guess it would have been better if I had used something that doesn't flex as much. Anyway, as I thought about it, I realized the keys would have to be mounted so they don't short to each other. That ruled out my first idea of using a screw shaft to hold them together. I guess a nylon screw would have worked, but I didn't

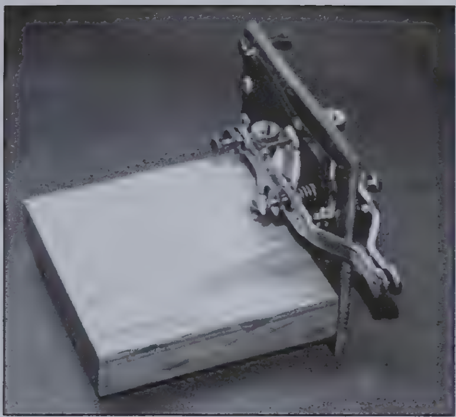


Figure 5—Two code practice keys make an iambic paddle.

have any, so I used Gorilla Glue™, advertised as "The Toughest Glue on Planet Earth"™. It takes a few hours to harden, but it is really tough stuff!

I spent some time experimenting to find the ideal location on the board, so that the angle would be exactly right and they could close on their respective contacts without touching each other. I glued one side first, let it dry, and then the other. Obviously, if you use the glue, it's going to take a couple of sittings to complete.

I found all of the hardware I needed was right there in those "antique" keys. I did modify one screw, the one that holds the contacts to the plastic bases—you know, the point where the key makes contact when you press it. Except for the terminal posts, these contacts were to be the only connection from one side of the vertical board to the other. I cut off the head of the screw with a bolt cutter and used it to hold the two contact points together, on opposite sides of the board.

A strip of steel flashing from the keys connects the two contacts to the ground (earth) terminal post. More of the same material, held on with one of the short screws, connects the key mechanisms to the other two terminal posts. There was a lot of steel flashing left over when I was done. This stuff is much classier than wire. It kinda lays flat against the board and even shines a bit!

The original key knobs were way too big to use as paddles, so I removed them from the ends of the keys as shown in Figure 5. During actual QSOs with the key, I discovered I needed more to push on than the round ends, so I glued two brand new pennies on the ends for paddles. They work perfectly. You could also buy custom paddles and mount them using the threaded holes in the key ends. But mine were cheap!

I was really amazed how easily the whole thing went together. The vertical board is screwed to a block of hardwood to give it some weight, with three wood screws that are the only real hardware I needed to add to the parts that came with the keys. Both keys are fully adjustable, just like the classic J38 key: the pivots, the height above the contacts, and of course, the spring tension. With everything carefully adjusted, the key operates with a slight touch, perfect for iambic keying.

In the end, my "homebrew" paddle key works great, even though the vertical mounting board could have been made of something a bit stiffer, like Plexiglas. I use a rubber pad under it to keep it from walking all over the table, characteristic of any light paddle. I am sure someone with more skills than I could have done a better job, but I am tickled that it worked out and very happy how well it works. It sure was a lot cheaper than a new commercial key! Maybe someday it will end up on a collector's shelf—you never know.

—de AI2T

Re-sticking Rubber Feet

Self-adhesive rubber feet are used a lot in homebrewing, but they don't always stick well. This discussion appeared recently on one of the online QRP-L forums—

From KØCD—I just finished another Modified BLT tuner. I had painted and then clear coated the cabinet and attached the feet. The adhesive on them has turned gummy. Are there any suggestions on how or what to use to have the feet solidly attached?

Reply from K2UD—I would try one of two things. Scotch double-stick tape, which is the same thickness as standard Scotch tape and can be trimmed with an X-Acto blade, or a thin coat of contact cement.

From KI4YZE—GOOP or a product called 6000 or G6000 will work well; available at hardware stores, "Wally World," home centers etc.

Finally, from AA1IP—The local JoAnn's Fabric store has a product called "Zots" manufactured by Thermoweb (www.thermowebb.com). The Zots consist of blobs of clear adhesive backed by a waxed-paper tape. You touch a Zot to the point of adhesion and peel away the paper. Various sizes are available, as are strips of the same material. These should be ideal for reattaching rubber feet to cabinets, and for applying cabinet trim.

If I recall correctly, the price is approximately $3.00 for a box of 300 Zots. I recently purchased a box of the 1/4-inch size to experiment with—possibly for securing soldering pads to a substrate for Manhattan-style breadboard construction, but I haven't yet had a chance to see whether they resist soldering temperatures.

Other possible applications include temporarily securing components while you solder their leads, and fixing multilead connectors in place for soldering.

Utility Power Supply Using a Four-Terminal Regulator

Everyone knows all about three terminal regulators, which have been around "forever," but who knows anything about four terminal regulators? But they are out there, and if you come across one some day you won't be in the dark. Bryant Julstrom (KCØZNG, kc0zng@arrl.net) describes a project using one of these devices—

When we design and build circuits, we needn't always be on the cutting edge of technology. As the MPF102 FET and NE602 mixer remind us, older devices can be just as convenient and useful as more recent ones. A case in point is the UA78, a four-terminal positive voltage regulator.

Fairchild introduced four-terminal regulators in several packages at about the same time that the more familiar three-terminal regulators began to appear; that is, more than thirty years ago. Like their three-terminal cousins, they require only a few external components and so are very easy to use. Unlike the three-terminal regulators, they have a separate control terminal; they work by maintaining this terminal at a fixed voltage from ground. For the UA78, that voltage is +5 V, as Figure 6(a) from Horowitz and Hill (ref. 1) illustrates. With +15 V at the regulator's output, the voltage divider applies +5 V to its control terminal; the regulator adjusts the output to maintain this condition.

Four-terminal regulators were manufactured in several forms, including TO-220 and TO-3 packages. As with the three-terminal regulators, there were negative as

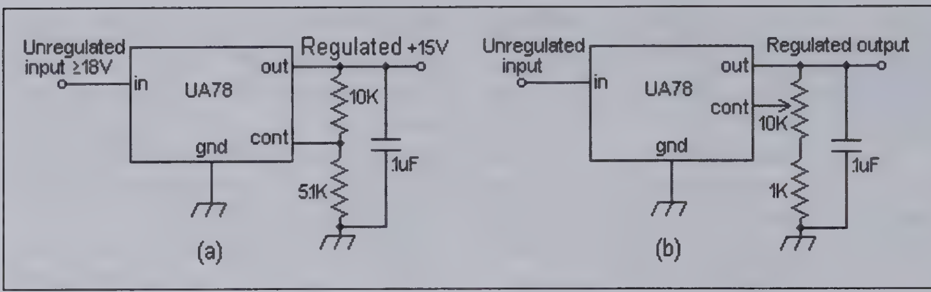


Figure 6—The UA78 as a fixed (a) and an adjustable (b) voltage regulator.

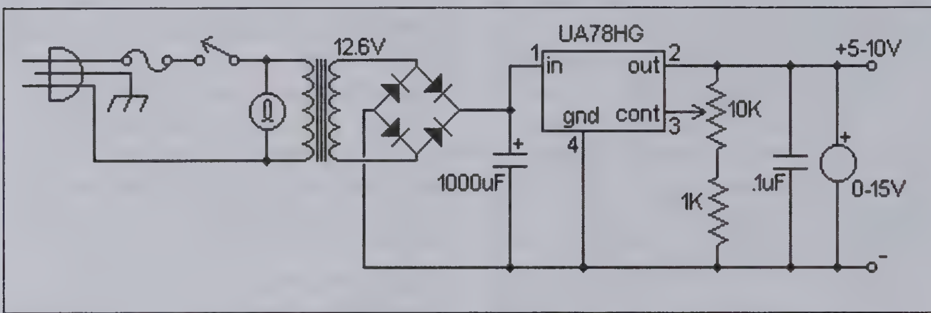


Figure 7—A complete adjustable, regulated power supply using a UA78HG.

well as positive versions; the names of the negative ones include the number 79. Even though these regulators have been out of production for years, their datasheets are easily available on-line.

Replacing the fixed voltage divider in Figure 6(a) with a potentiometer yields an adjustable regulator, with output from 5V to a volt or two less than the input voltage. Figure 6(b) illustrates this extension of the first example. The 1k fixed resistor ensures that the control terminal always receives a non-zero voltage from the divider.

Four-terminal regulators appear only rarely in the amateur radio literature. The only examples I could find were a passing mention in a 1978 article by W6GXN (ref. 2), and supplies by W1SNN (ref. 3) W6YUY (ref. 4) in the following year or so. Horowitz and Hill dispense with them in two paragraphs (ref. 1).

I was recently given three UA78HGs, which are UA78s in TO-3 packages, and I thought it would be interesting to explore their behavior and build a small adjustable power supply using one of them.

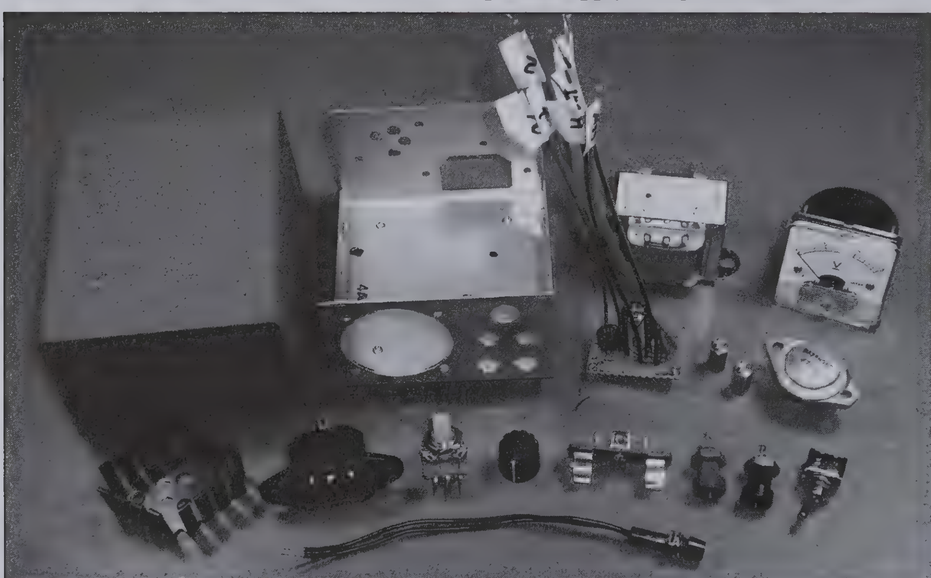


Figure 8— The components of the supply, laid out before assembly.

A Utility Power Supply

Since the circuit in Figure 6(b) has so few parts, breadboarding it didn't even require a breadboard; I used clip leads and confirmed that it worked. I decided then to build a complete power supply, whose circuit Figure 7 shows.

In the usual ham style I determined to use as many junk-box parts as possible. These included a UA78HG (of course), a small Radio Shack enclosure (no longer available), an IEC line connector, a fuse holder and fuse, a 10k pot and knob, banana jacks, a miniature SPST switch, an indicator, all the small parts, and a recent hamfest purchase: a tiny 0-15 VDC analog panel meter. The enclosure constrained my design, but in a good way; the supply would be very small. I ordered a transformer that would fit in the enclosure and a TO-3 heat sink.

When I got the meter its crystal was yellow, probably from cigarette smoke, but it detached easily and cleaned up with water, dish soap, and a Q-tip. *[For the benefit of non-US readers, that is a widely available brand of cotton swab.—'MCQ]* I was pleased that the meter was labeled "Lafayette." Forty years ago I built a Lafayette short-wave receiver (a KT-320) from a kit, and the company has occupied a warm space in my heart ever since. (The receiver still occupies a space in my shack.)

Construction

The only small parts the supply uses are the bridge rectifier, filter capacitor, 1k resistor, and 0.1 µF bypass capacitor, so a circuit board was not strictly necessary. Nonetheless I put these parts on a piece of perf-board, to provide convenient junctions for the connections to the remaining (larger) parts.

Two features of the UA78HG influenced the supply's construction. First, unlike most TO-3 packages, it has four pins. Two are in the usual locations, but the heat sink had to be carefully drilled to accommodate the other two. The enclosure's back panel required matching holes, but these were easy with the drilled heat sink as a template.

Second, all the regulator's connections come out to pins. The UA78's case is electrically neutral and can be attached to the heat sink and the enclosure without an insulator. A little silicone grease between

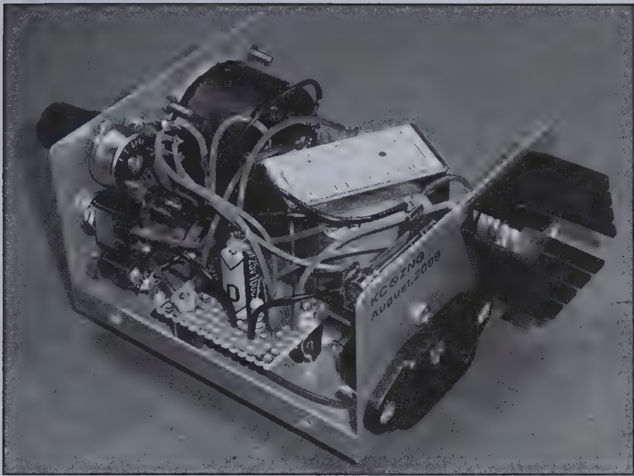


Figure 9—The interior of the completed supply, showing the arrangement of its parts.

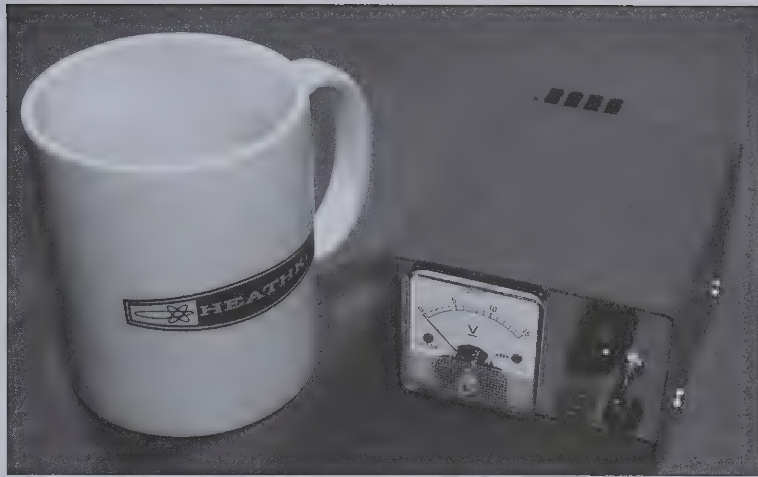


Figure 10—The completed supply in its enclosure, with a coffee mug for scale.

the several surfaces is still a good idea. The pins are numbered on the case, which helps get the connections right; I copied them with a Sharpie [marker pen] onto the inside of the enclosure. There was just room on the enclosure's back panel for the heat sink and IEC power connector. Figure 8 shows the enclosure and all the parts, ready for assembly.

In spite of the tight quarters the supply went together almost without a hitch, though I had to be careful to work from the front and back panels in and from the bottom up to avoid blocking new connections with old. All the other wiring was complete before I installed the transformer; it takes a lot of the space in there.

During assembly one of the terminals on the pot broke off, but I was able to solder it back on in place. This connection may be a weak spot, and I'll keep an eye on it. Figure 9 shows the interior of the completed unit and the placement of its various parts, and Figure 10 shows the completed unit from the front. The mug is there for scale (and because I like it).

Performance

The completed supply provides regulated output of several hundred mA from 5V to about 10V. With its voltage set to 8V, it supplies over 0.7A to an 11 ohm power resistor used as a load. When this load is removed, the supply's voltage rises only 0.01V; like its three-terminal relatives, the UA78 does a good job.

The transformer I bought was the smallest 12.6V one I could find rated at 1A. However, under moderate load the supply's output voltage does not exceed 10V (no surprise) and the transformer's voltage collapses as current near 1A is drawn from it. The supply's usefulness would be greater with a transformer that provides more current at a slightly higher voltage, but such a transformer would have been physically too large to fit in the enclosure.

The maximum current that the UA78HG can pass is 5A, so this supply does not test the regulator's limits. Indeed, the UA78 will never be called on to dissipate more than a few watts, so its heat sink is probably unnecessary. Clearly one could build a larger supply. This would require a larger transformer and enclosure and a substantial heat sink. Any wiring that carries the supply's output must be large enough for the maximum current.

In spite of its limitations, this supply has gotten a lot of use on my workbench. Many circuits, especially for QRP operation, require less than 1A of current, and the supply doesn't take up much space. It's a handy little item, and it demonstrates that older and less well-known hardware can be useful.

References

1. Paul Horowitz and Winfield Hill, *The Art of Electronics* (Second Edition). Cambridge: Cambridge University Press, 1989, p. 345.

2. Henry Olson, W6GXN: "Feeding a Hungry Microcomputer—power supplies." *73 Amateur Radio,* April, 1978, pp. 76-82.

3. Stirling M. Olson, W1SNN: "Four Terminals Are Better Than Three—using the new voltage regulators." *73 Magazine,* November, 1978, pp. 226-227.

4. Robert E. Bloom, W6YUY: "Power Plus!—a 20-Amp, adjustable, regulated dc supply." *73 Magazine,* March, 1979, pp. 42-44.

—de KCØZNG

Installing the Freq-Mite in the Heathkit HW-8

Described in the December 1998 issue of QST, the Freq-Mite is a small, handy frequency counter with audible "display" that you can put into a QRP rig to augment whatever dial marking method it uses. The output is in Morse code, and can be used with any HF QRP rig. (More info is available at smallwonderlabs.com. Small Wonder Labs is operated by Dave Benson, K1SWL.)

On his web page, William Eric McFadden, WD8RIF, describes how he installed one in his Heathkit HW-8—

Mounting Freq-Mite Circuit Board & Circuit Ground

Using the supplied right-angle bracket, I mounted the Freq-Mite to the HW-8 inner front panel at the meter mounting screw located nearest to the VFO capacitor. Because the mounting hole on the Freq-Mite circuit board is also a ground pad, circuit ground is achieved mechanically through this mount. Figure 11 shows an overall view of the mounting location and Figure 12 is a closer view.

Pushbutton switch:

The switch is a momentary contact, normally open pushbutton. To mount it, I

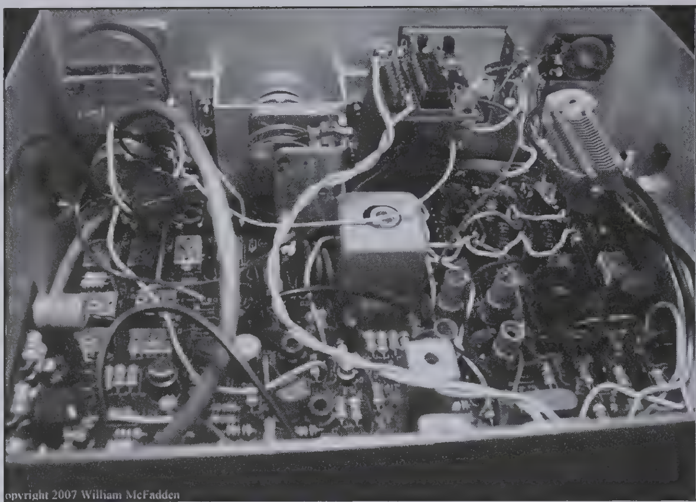


Figure 11—Freq-Mite mounted in an HW-8, between the two variable capacitors.

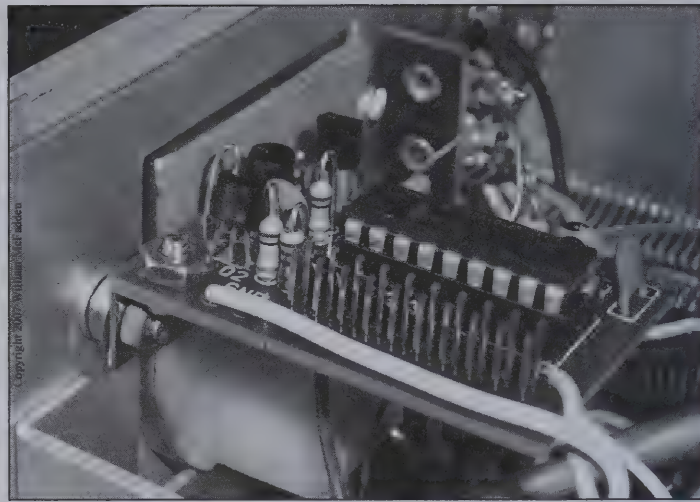


Figure 12—Close-up view of the Freq-Mite, mounted near the rig's meter.

drilled a hole in the back of the cabinet about 1.25" above the key socket. Figure 13 shows the switch mounted in this hole. From the S1 and GND pads on the Freq-Mite, I ran a twisted-pair of wires to the switch. These wires are visible in Figures 11 and 12. Because there's a mechanical connection to chassis ground at the Freq-Mite mount, the GND wire is probably not necessary for operation of the device.

RF Pickup

The RF signal for the Freq-Mite is picked up at the HW-8's Test Point 2 (TP2). This is located at the leg of R49 nearest to the large shielded inductor L9 in the middle of the transceiver's main circuit board. For this connection I soldered directly to R49's leg. In Figure 14, the RF pickup is the wire going up to the right in front of the L9 shield.

AF Out

The audio output signal from the Freq-Mite is connected to the center connection of the transceiver's AF-gain potentiometer through the supplied 100k ohm resistor. The HW-8 uses concentric controls for on-off, AF gain and RF gain. The AF gain potentiometer is the middle of these. The center connection of the potentiometer is the AF gain output. By using this connection instead of the input, the Freq-Mite audio level remains constant—the transceiver volume can be turned all the way down for easy copy of the Freq-Mite. In Figure 15, the white wire is the Freq-Mite AF Out.

12V DC

DC power for the Freq-Mite is achieved with a connection to the output of the transceiver's on-off switch. This switch is the rear-most of the three concentric controls described above, and the output is the terminal with the yellow wire going to point E on the transceiver's main board. In Figure 16, the DC power connection is the smaller red wire. (The larger red wire brings transceiver power from the six-pin Molex connector on the back of the rig.)

Jumpers and Operation

Because of the HW-8's direct-conversion design, no offset jumpers need to be installed on the Freq-Mite. Upon application of power to the transceiver, the Freq-Mite sends "s?". Press the button once if you want readout to be at 26 wpm instead of the default 13 wpm. The Freq-Mite will send "i?" to ask if the frequency calculation should be inverted. Do not press the button since you don't want it to be inverted.

Finally, the Freq-Mite will send the

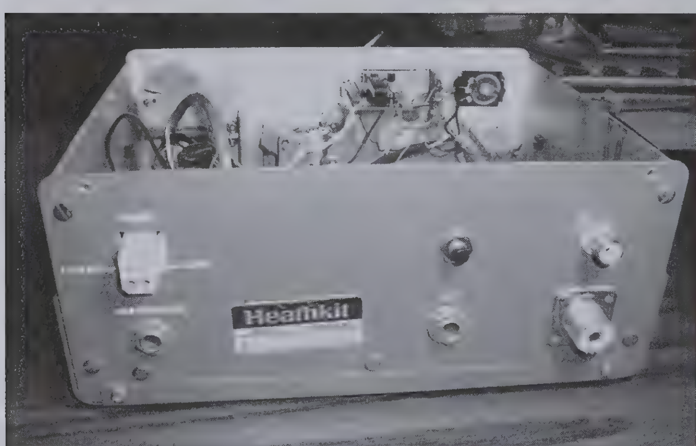


Figure 13—A pushbutton switch is added above the key jack. (Any convenient location of your choosing will do.)

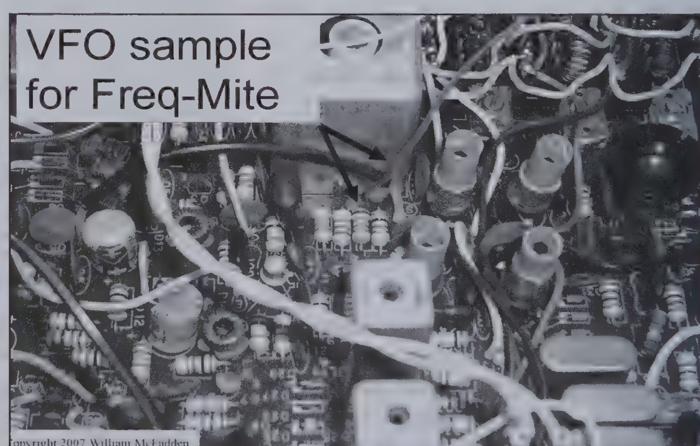


Figure 14—A sample of the VFO signal is picked off for the Freq-Mite.

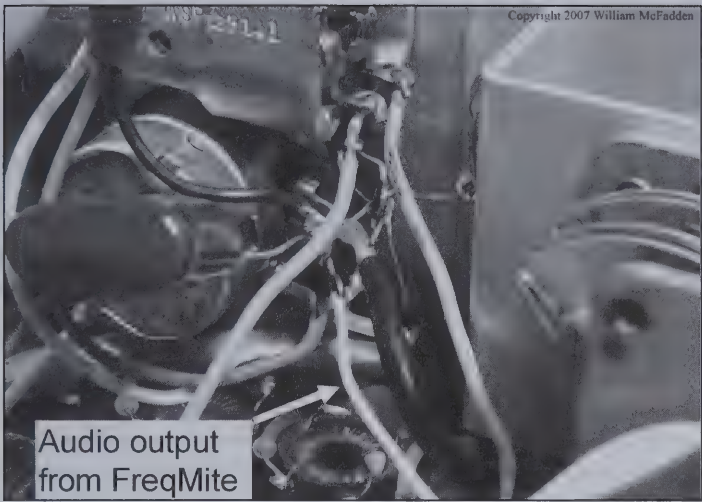


Figure 15—The Freq-Mite output is fed to the output side of the volume control.

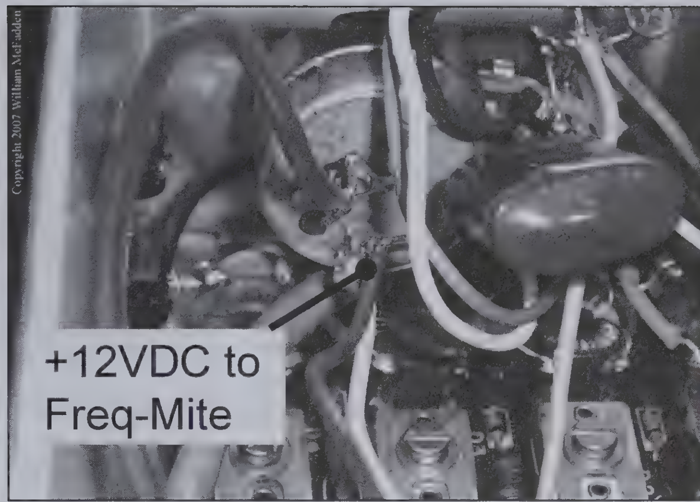


Figure 16—Voltage is tapped from the power switch.

prosign "AR." Any button-press at this point will cause the Freq-Mite to send the least three significant digits of the frequency. (Example: with the transceiver 40m band switch depressed and the VFO dial set to 100 for a selected frequency of 7.100 MHz, a button press will cause the Freq-Mite to send "100." If band noise prevents copy of the Freq-Mite, turn the transceiver's AF gain down all the way and press the button again.

[The WD8RIF home page is at http://home.frognet.net/~mcfadden/wd8rif/radio.htm. The text and photos here are copyright, WD8RIF.]

—de WD8RIF

Linear Scale Analog Wattmeter

Actually, this isn't about making a wattmeter; it's about modifying one you already have to give a different meter scale. Just about every one I've ever seen has the numbers spread out on the lower end of the scale, becoming increasingly scrunched together as you go higher. It would be nice to have a linear scale, with them spread out evenly. Adding this additional circuit from Steve Weber, KD1JV, does exactly that—

Wattmeters which are built using an analog meter for the indicator require redoing the meter scale. This is because power is a squared function of the detected voltage. Therefore, one must calibrate the meter at quite a few points. Typically for a QRP wattmeter we would mark the 0.5, 1, 2, 3, 4 and 5 watt points on the meter. Reading power which doesn't fall on one of the calibration "ticks" is often misread, as half way between, say, the 1 and 2 watt marks is not 1.5 watts. It's more like 1.25.

The way to solve this problem is to use an analog multiplier circuit to square the detected voltage from the SWR bridge. Looking though an old National Semiconductor linear applications book, I found a reasonably simple circuit which will square an input voltage and convert it to a current suitable for driving an analog meter. I put one together and it works great. The schematic is shown in Figure 17.

This circuit does have a few quirks. One, it requires the use of dual transistors. The application note shows the use of LM394 super matched pair transistors in a TO-5 can. These are still available, but at over $5.00 each, and you need two sets. I happened to have a couple CA3046 transistor arrays to use. These are still available from Jameco. If you don't mind using SMT parts, Digi-Key has an MMPQ2222ACT in a 16 pin SOIC package, which is a 2N2222A transistor array.

I did try using 2N3904 transistors, but there is excessive drift due to temperature. Just putting a finger on one of the transistors causes radical meter drift. It's remotely possible that one could get these to work by thermally bonding them to a common piece of aluminum.

The original circuit uses a regulated

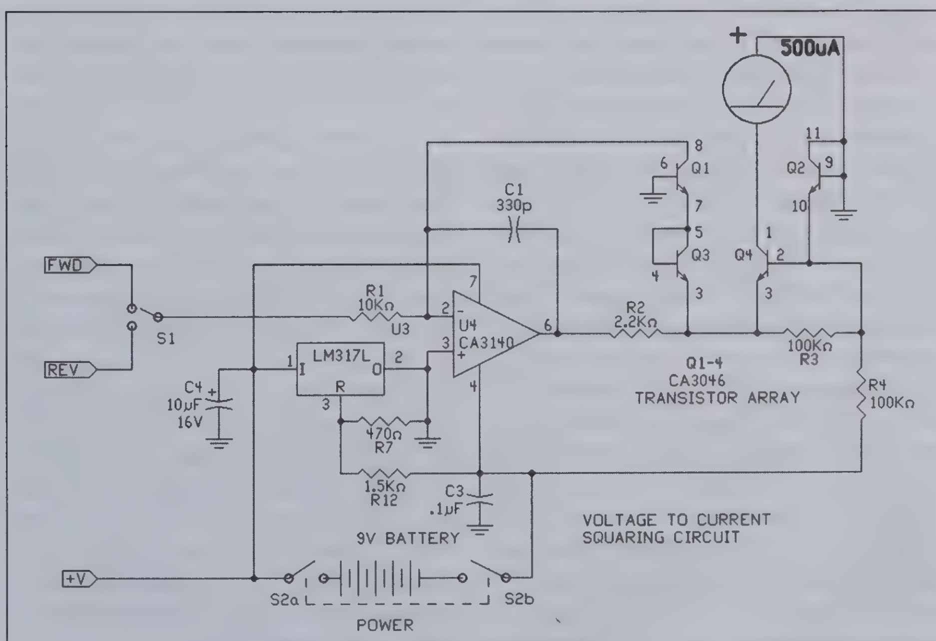


Figure 17—Adding an analog multiplier to a wattmeter gives a linear scale.

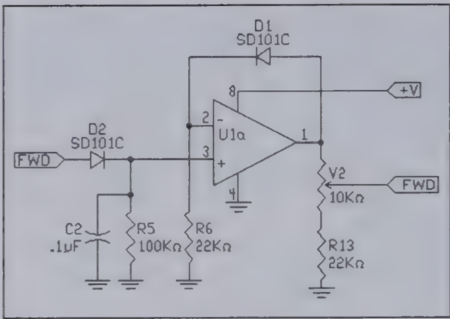


Figure 18—Adding a diode compensation circuit corrects for nonlinear response of the detector diode at low input voltages.

negative supply. This required powering the circuit with two 9 volt batteries. I was able to modify the circuit so it would run on a single 9 volt battery. This was achieved by using a LM317L adjustable voltage regulator to create a "pseudo ground." The output of the regulator is connected to circuit ground, while the negative end of the battery is left floating. The regulator keeps a constant voltage between ground and the negative side of the battery. This allows the output of the op amp to swing negative in respect to ground, which is required to make the circuit work.

[WA8MCQ note—In a recent e-mail, Steve told me "...powering it with a 9V battery is a little marginal. A 9V AC adaptor is better, as they put out more like 12 volts, with a light load."]

Q1 in the op amp feedback loop squares the current because of the current gain relationship between the emitter and collector currents. Q4 mirrors the current in order to drive the meter. Replacing the meter with a resistor would give a voltage output, which could go to a digital voltmeter or multimeter.

I used a CA3140 op amp, because I had them and its output will go to the negative rail. A CMOS rail to rail output op amp could be used instead and a LM358 should work as well.

Potentiometer V2 in the diode compensation circuit of Figure 18 is used to calibrate the meter. Increase the value of R1 to make the meter less sensitive, should you want to measure higher power levels. I happened to have a nice 500 μA meter with a 0-500 scale to use. Meters with other sensitivities could be used; adjust the value of R1 to compensate.

The diode compensation circuit of Figure 18 linearizes the SWR bridge detector diode. This circuit "adds back" the forward drop of the detector diode and compensates for the non-linear response of the detector diode at low input voltages. This results in greatly improved accuracy. U1 needs to be a rail to rail output type so the output can go to ground. Two of these circuits are needed if accurate reverse power is to be measured.

—de KD1JV

WA8MCQ notes: Used with permission, this article appears on Steve's web page at http://kd1jv.qrpradio.com/ along with a large number of other projects. It also has information on one of his most interesting designs, the ATS3-B. Available as a kit which is currently sold out yet again, but with another run expected soon, this is a six band HF CW/digital transceiver that fits into an Altoids tin! [It operates one band at a time using plug-in filter modules, which are included. Digital operation requires that you build your own PC interface] It even has it's own discussion forum on yahoogroups.com. You can contact Steve at kd1jv@moose.ncia.net.

Loop Retains Wire Test Point

Denny Baker, W9OCP, sent this tip recently—

Here's a tidbit about using a wire for a test point or connection to the circuit board. For years, I attached a test point by installing a wire with a small "L" at the bottom that is soldered to the trace as shown in Figure 19, but if I heat it too much it slides back into the hole. So here's a fix.

As shown in Figure 20, bend a wire back on itself and insert both sides into the hole/trace from the bottom of the board. Don't crimp the wire at the bend; leave a small loop and solder that to the board. Bend one side of the wire flat against the top of the board and clip it to leave 1/16" to 1/8". Now, when you solder to the wire, the little pigtail on the top of the board stops the wire from falling back through the hole if the solder melts and the small loop on the bottom stops the wire from pulling up through the hole. Give it a try. Works great!! No more problems with attaching test or access points to a circuit board. Why do these little tricks seem to take so long to work out??

—de W9OCP

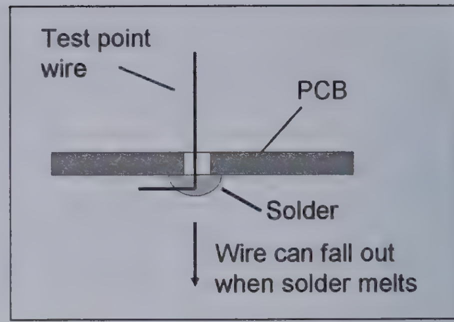


Figure 19—A wire test point on a PCB can fall out if heated too much.

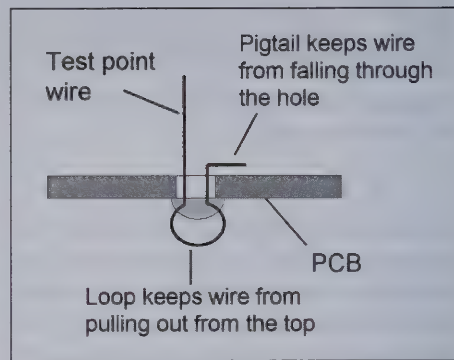


Figure 20—Make the wire test point a bit differently and it holds itself in place.

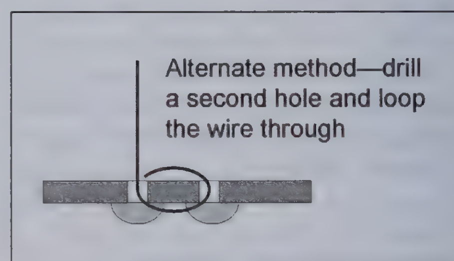


Figure 21—An alternate method for anchoring the wire test point if you don't mind drilling another hole.

WA8MCQ comment—An alternate method, which is a bit more work, is to drill a second hole close to the first one if there is room for it, then loop the wire around as shown in Figure 21.

Easy Magnet Wire Storage Method

Bob Kopski. K3NHI, posted this tip to the EMRFD discussion forum on yahoogroups.com a while back. (The forum was started by Roger Hayward, KA7EXM, and is for discussion of topics such as those found in the ARRL book *Experimental Methods in Radio Frequency Design*.)

Often, I have short magnet wire lengths that otherwise would be discarded or, if kept,

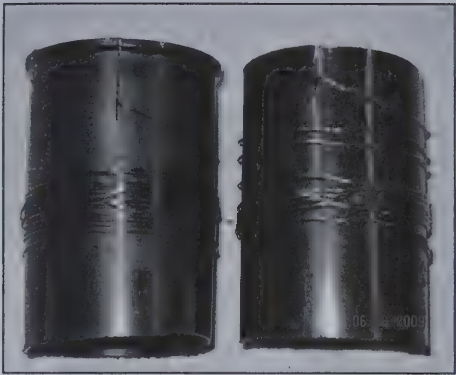


Figure 22—Cutting slits in a plastic 35 mm film canister makes a good storage device for small bits of wire.

become a scrambled mess. One example that I always want to keep tidy is what's left over from a lengthy bifilar or trifilar twist. Be it single strands or twists, the method shown in the K3NHI folder in the PHOTO section of the EMRFD forum and here in Figure 22 has proven quite workable.

This simple spool begins with a discarded plastic 35 mm film canister with the closed end cut off so as to form a tube. I then cut several small slits with a thin hobby saw around each end of the tube. I think an X-acto knife or even diagonal cutters will work as well. These cuts become "holder slots" for the wire ends.

As in the photo, just slip a wire end into a slit, wind it up, and tuck the final end into a slit at the other end of the tube. The film tube is very flexible plastic and this tucking-in is easy to do and holds nicely. I've used this scheme for wire over a very wide range of gauge sizes with good success. I think you'll find this approach a good hedge against today's copper prices!

—de K3NHI

(WA8MCQ comments—Since digital photography has mostly taken the world by storm, the days of 35 mm film are most definitely numbered. These canisters will probably disappear before too long although you can probably find someone who has a batch of them that they couldn't bring themselves to toss out. But you can use the same technique with small, round, soft plastic bottles.)

Absolute RF Power Measurement using Simple Techniques

This was sent in by Adam Farson, VA7OJ/AB4OJ. You can view the fancier

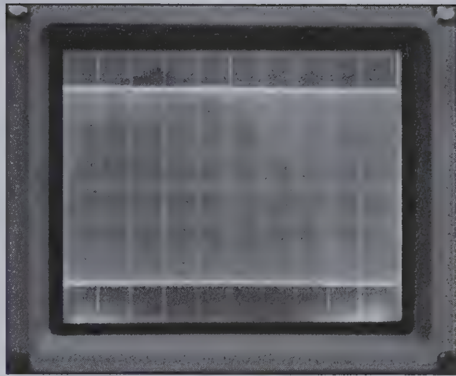


Figure 23—Scope display, 60 volts peak to peak (10 volts per vertical division).

version online at his web site, with the URL given at the end. He also includes links to some other interesting information.

Most HF amateur stations are equipped with some sort of RF power meter. The "SWR/power" meter is a popular instrument, and is also relatively inexpensive. It is basically a reflectometer in a metal case, with a meter (switchable or crossed-needle) which reads the DC output voltage of the reflectometer's forward and reflected power pickups.

These meters are usually designed for Z_0 = 50 ohms. They will read power accurately only if terminated in a 50 ohm resistive load.

The HF operator may wish to calibrate his SWR/power meter against an absolute power-measurement standard from time to time. Laboratory standards are very costly, and even an accurate commercial meter such as the Bird 43 represents a significant outlay.

If an accurate 50 ohm dummy load is available in the shack, we can measure RF power by measuring the RF voltage developed across the load. If a calibrated oscilloscope is available, we can connect our 10x scope probe across the dummy load, apply a CW signal from the transmitter, and measure the peak-to-peak voltage V_{p-p}. A typical oscilloscope display is shown in Figure 23.

The peak-to-peak voltage is 2.828 times the root-mean-square (RMS) voltage. $V_{p-p} = 2.828 * V_{RMS}$, so $V_{RMS} = 0.3535 * V_{p-p}$.

Average power $P_{AV} = (V_{RMS})^2 \div R$

P_{AV} is expressed in watts. (Note: We

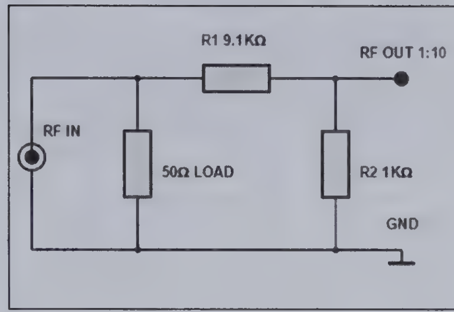


Figure 24—Schematic of 10:1 voltage divider.

are measuring the average power of a CW signal. "RMS power" is a misnomer!) *[WA8MCQ note—For details, read the online W7EL paper titled "RMS Power" listed at the end.]*

For example, if the oscilloscope reads 20 V_{p-p} with a 10x probe, $V_{p-p} = 20 * 10 = 200$ V.

Thus, $V_{RMS} = 0.3535 * 200 = 70.7$ V

$P_{AV} = (70.7)^2 \div 50 = 100$ W.

A 10:1 resistive voltage divider may be connected between the dummy load and the oscilloscope probe to reduce the RF voltage applied to the probe, as shown in Figure 24. The resistors should be non-inductive, and of adequate power rating.

In the example shown in Figure 24, R1 = 9.1k and R2 = 1k. At 100W in 50 ohms, the power dissipated in R1 + R2 is $(70.7)^2 \div 10000 = 0.5$W. ($P = V^2 \div R$). Thus, R1 and R2 should be 1 watt and 0.25 watt metal-film, respectively. Leads should be kept as short as possible.

A simple diode probe connected to a digital multimeter (DMM) is a reasonably accurate alternative if an oscilloscope is not available. Figure 25 is a schematic of a typical probe.

The diode probe is a half-wave peak rectifier; its output voltage is equal to the peak value of the applied RF voltage, less the diode barrier voltage. To minimize the diode drop, D1 should be a germanium diode such as 1N34A, OA90 or OA91. These diodes have a barrier voltage of approx. 0.25V vs. 0.4V for a Schottky diode (e.g. 1N5711) or 0.7V for a silicon diode (e.g. 1N4148). The OA91 has 115V PIV, but may be difficult to locate. A 1N5711 Schottky diode (PIV = 70V) may also be used for D1.

A silicon diode such as the 1N4148 is

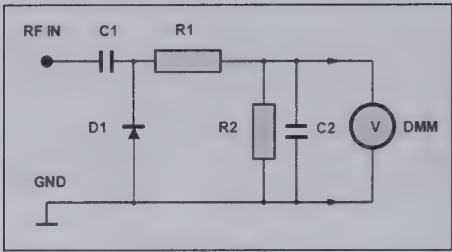


Figure 25—Schematic of typical diode probe.

not recommended, as its higher barrier voltage will introduce greater error at low power levels.

Assuming that D1 is a 1N34A, the applied peak RF voltage is equal to the DC output voltage + 0.25V. Thus,

V_{PK} = (VDC + 0.25) volts, or VDC = (V_{PK} – 0.25) volts.

As for the oscilloscope case:

Average power $P_{AV} = (V_{RMS})^2 \div R = (0.707\ V_{PK})^2 \div R = (V_{PK})^2 \div 2R$

Thus, $P_{AV} = (Vdc + 0.25)^2 \div 2R$

Example: VDC = 20V, R = 50 ohms. $P_{AV} = [(20.25)^2 \div (50 * 2)] = 4.1W$

In Figure 25, R1 = 470k, and R2 = 1.1M. These resistor values provide scaling from peak to RMS for a sine-wave input. A DMM with Z_{IN} >10M will not significantly load down the probe. The DMM reads 0.7 * VDC or 0.7 * (V_{PK} – 0.25), which is pretty close to V_{RMS}.

For the above example, if P_{AV} = 4.1W, V_{PK} = 20.25V, and the DMM will read 14V. (V_{RMS} = 0.707 * 20.25 = 14.3V).

Because of the PIV limitations of the diodes, the 10:1 voltage divider (Figure 24) must be placed between the 50 ohm dummy load and the probe for higher power readings.

Example: For P_{AV} = 100W, $V_{RMS} = (PR)^{1/2} = (100 * 50)^{1/2} = 70.7V$

V_{PK} = 1.414 * 70.7 = 100V. The divider ratio is 10:1. Thus, V_{PK} = 10V at the probe input. The DMM will read 0.7 * (10 — 0.25) = 6.8V

The probe should be built into a metallic shielding enclosure. Leads should be kept as short as possible.

For those who would prefer to purchase and build a kit, Elecraft (www.elecraft.com) offers an RF probe kit for $10.00 under their order code RFPROBE.

Additional info online:

1. Absolute RF Power Measurement using Simple Techniques [online version of this article]: http://www.ab4oj.com/test/pwrmeas.html
2. A Simple SSB PEP Measuring Procedure: http://www.ab4oj.com/test/peptest.html
3. Measuring RF Voltage, Current, Power and SWR: http://epic.mcmaster.ca/~elmer101/rfpower/rfpower.html
4. N5ESE's RF Probe: http://www.io.com/~n5fc/rfprobe1.htm
5. "RMS Power," by Roy Lewallen W7EL (PDF): http://www.eznec.com/Amateur/RMS_Power.pdf
6. "What's RMS Power or RMS Watts?" by Paul Quillen N4LCD (PDF): http://www.n4lcd.com/RMS.pdf

—de VA7OJ/AB4OJ

Quick and Dirty Antenna Switch

Here's one from the "a picture is worth 1000 words" file. I found the photo in Figure 26 on qrpedia.com with no comments or details, and it doesn't really need any. The picture pretty much says it all. A small toggle switch is soldered to some UHF connectors that are bolted together and it makes a handy light duty, low power switch. (If I were the sort of person who goes backpacking with radios, I'd probably add a little bracket to keep stress off the terminals. I'd hate to have a portable QRP operation cut short by a fractured solder joint.)

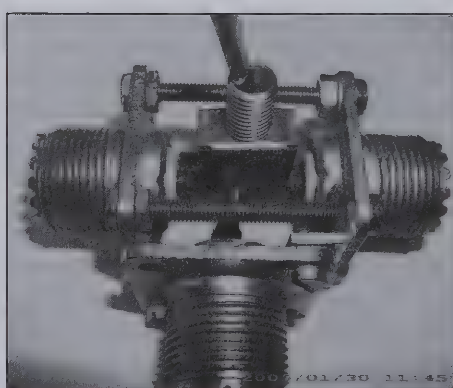


Figure 26—Quick and dirty antenna switch from DL2QA.

This came from qrpedia.com, a web site started a while ago by Jason Mildrum, NT7S. One of the sections on it is "Workbench—Hints and more Hints," a collection of things from DL2BQD. It has all sorts of good ideas; you'll find this one toward the end, and it came from Elmar, DL2QA.

Amplified Speaker for MP3 Player

Here's another project from the web page of Steve Weber, KD1JV. (Although intended for use with a stereo device, it can be used with anything having a mono output, such as a QRP rig; just use one input.)

This amplified speaker fits into an Altoids sized tin box, runs on three "AAA" batteries, weighs 3.4 oz (with batteries) and can produce room filling sound with remarkable fidelity when combined with an acoustic "bass enhancing" resonator (empty plastic peanut butter jar).

The best sound is obtained when the speaker is placed over the open top of an 18 oz. empty peanut butter jar and the lid of the tin is opened slightly, as shown in Figure 27. The jar enhances the bass and the open lid enhances the treble, which comes out of the top of the speaker. As a bonus, the tin will just fit inside the peanut butter jar for transportation, so you don't need to carry an empty jar!

By the way, this same idea can be used with any device with a small speaker. A Nalgene bottle will work too. The improvement in sound quality and volume is remarkable.

A 2" diameter "flat" Mylar speaker is mounted inside the tin. One large hole and a number of smaller 1/4" holes are drilled over the speaker to let the sound out (Figure 28). The speaker cannot be mounted directly to the bottom of the tin; it must be spaced a little off the bottom so the cone does not touch. I used a piece of 1/4" thick foam core construction board to make a spacer for the speaker. The speaker is simply hot glued to the construction board. A piece of black felt cloth is then glued to the spacer to protect the speaker cone and make it look better. (See Figure 29.)

This speaker assembly is then hot glued into the bottom of the tin, over the holes drilled for the speaker. There is just enough room left to place a three cell "AAA" battery holder in the other end of

Figure 27—Amplified speaker placed over open jar for enhanced sound.

Figure 28—Drill holes in the bottom of the tin to let the sound out.

the tin (Figure 30).

The amplifier to drive the speaker is made from two LM386 low voltage amplifier chips (Figure 31). These are configured as a "bridge" amplifier, where the speaker is placed between the outputs of the two amplifiers. This doubles the amount of power which can be delivered over using just one amplifier for the same battery voltage. The left and right channels from the MP3 player are "summed" by three resistors to the inputs of the amplifiers, which converts the stereo signals from the player into a monaural signal because only one speaker is used.

A headphone cable clipped from a cheap pair of headphones is used to connect between the amplifier and the player. I built the amplifier circuits using tiny SMT (surface mount technology) parts because there wasn't much room left in the tin after adding the speaker and batteries. An experienced circuit builder could likely use larger "through hole" parts and make the profile low enough to fit the amplifier over the battery holder. If you are knowledgeable about electronics and making that kind of stuff, the schematic diagram should be all you need to duplicate this.

—de KD1JV

Figure 29—A spacer is glued to the front of the speaker so nothing touches the cone.

The Fine Print

As always, if you have anything you'd like to share, get it to me any way you can, in any form (paper, floppy, CD, e-mail), and don't worry if it's not polished or if you just have hand drawn schematics. Our skilled staff (me) takes care of all of that automatically. All you need to worry about is getting it to Severn.

—de WA8MCQ

[Every homebrewer has a few tricks to make building easier. Tell Mike C about about yours and it might appear in the Idea Exchange column! Send them to Mike at wa8mcq@verizon.net. You can also send them to the Editor or one of the Associate Editors listed on page 3—Ed.]

Figure 30—Everything mounted in the Altoids tin. The power switch is attached to the inside of the lid.

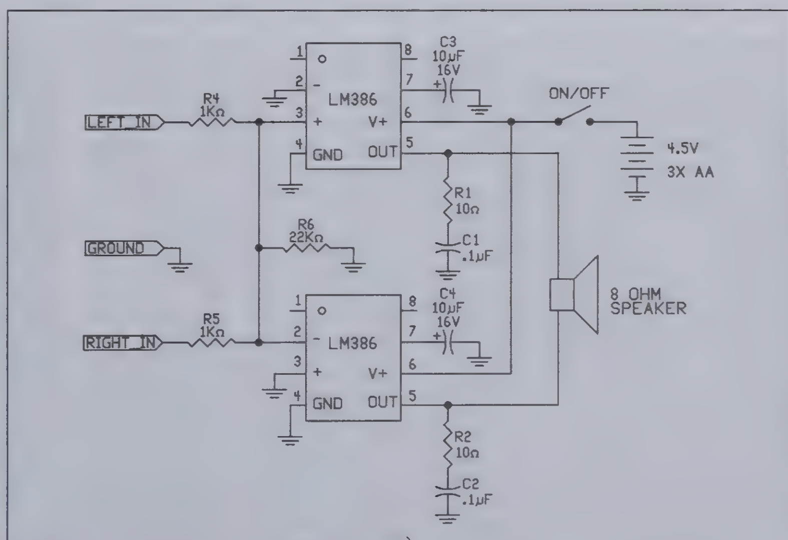


Figure 31—Schematic of the amplified speaker.

A Tale of Two Hilltoppers

Dennis Markell—N1IMW

Dennis, N1IMW

Antenna Height—we all crave it, right? Well, if you don't have a monster tower, here's your best option: Climb a mountain! Hilltopping can get your gear up and your signal out. However, it takes a unique individual to attack the hiking trails and back roads that are the hallmark of QRP hilltop geography. This is the story of two such individuals, Jim K1JAW and Jim W1PID. They are avid New England Hilltoppers. They have never met, but they share a passion for outdoor QRP. W1PID is an ultralite backpacker from Sanbornton, NH. K1JAW is from Longmeadow MA and is a camper and back road operator. Both men love the outdoors, love to have radio fun and know how to make loads of Hilltop contacts!

W1PID

Jim's QTH is Sanborn NH and it rests in the Lakes Region in Central NH within a short 30-60 minute ride to the 3000-6000 ft peaks of the White Mountains. Jim enjoys the 1000-2000 ft. hills like Knox Mountain. These hills give Jim the chance to it the hilltop on short notice for a 2-3 hour outing. Knox Mountain is a 1300 ft summit and has handed W1PID and his fellow QRPer Hanz W1JSB, some excellent QRP DX including Greenland, Brazil and Uruguay. Better yet, Knox Mountain comes with a tailor made cabin that has a great open porch area, making for drier operating during downpours. Jim got his start in hilltopping more by accident than plan. "Twenty years ago I started. All I wanted to do was operate outside of the house. I didn't even have a QRP rig. I just took my Ten-Tec Scout with a car battery, set it on the picnic table, and tossed up a dipole and I worked the world!"

A QRP rig collection has since been accumulated. "I have so many now; I don't even know what I have." However, Jim knows what his current favorite rig is: "The Steve Weber ATS3A is superb... it's a joy to backpack and operate. It only weighs a few ounces. I power it with a 750 mAH LiPo battery." Favorites aside, we all like a little variety in our gear and W1PID works a Cub and an FT-817 as well.

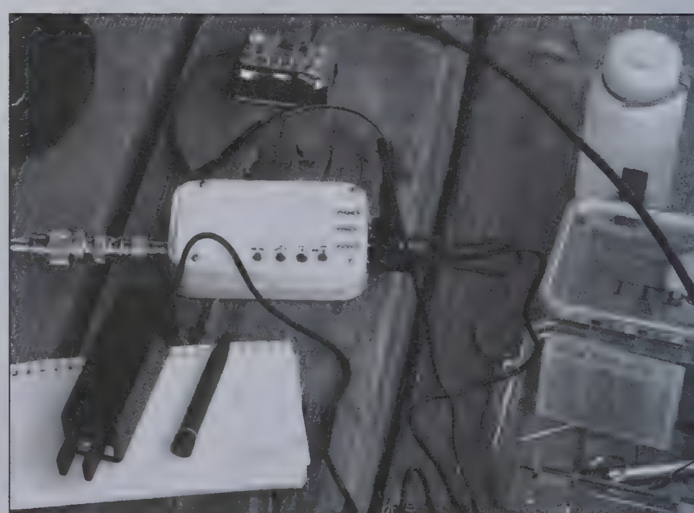
Jim W1PID uses a 33 ft wire vertical with coil loading. "The coil is the size of a 35 mm film canister; just the right size." Position is critical with the antenna. "I set up immediately below the hanging wire and coil, no angles allowed. The wire must be perfectly perpendicular to ground."

The vertical angle needed was made clear one day when operating with Dick N1LT. According to Jim W1PID, "Dick chose a pine farther away from the cliff. Even though his wire was about the same length as mine, his vertical was sloped at nearly 40 degrees. The difference between the two antennas was soon to become critical. Dick N1LT was able to work Jurek, EAU6UN but with low signal strength only. Jurek could hear Dick's signal, but not well enough to get his call. So I gave him a try with my setup. I'll be darned if he didn't answer and give me a 569 report. The only significant difference between Dick's setup and mine was the angle of radiation from the two antennas. What a difference a few degrees can make."

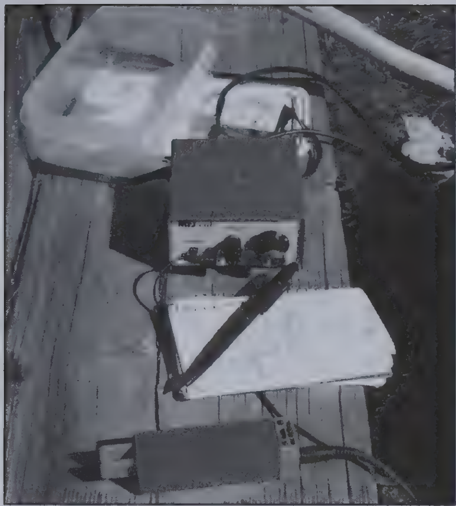
Gearing up for QRP hilltopping is fun. Buying and building rigs; designing and setting up antennas is such an important part of our QRP World. However, when we are all done with the technicalities, the formulas, the ratios and the gear, QRP hilltopping is really about the feeling of being outdoors with radio. Jim stated so clearly after hiking and operating along New Hampshire majestic Pemigewassett River, "It's all magic. The radio contact, the colors, the sky, the river and the land."

K1JAW has a different approach to hilltop QRP. In fact, I've ever heard Jim K1JAW speak of a back pack or a hiking trail. K1JAW's hilltopping is a different experience from his neighbor to the north, W1PID.

Jim, W1PID.



AT3SA.



MFJ Cub Rig.

Jim, K1JAW.

Jim is the definition of a relaxed operator. Friendly, inclusive and jovial are words that describe this QRP man. Jim is the guy at Hamden County (MA) Radio Association that greets the new guys, runs the "new guy" net on Thursday night and always waits and checks on the repeater for new entrants. So it was no surprise to me, when I asked what his next QRP challenge would be: "Honestly, Dennis, I don't have a next challenge. I am not looking for a watt per mile world record and I don't do contesting. I just want to have fun with my radio"—and that he does!

Jim was a QRPer from the start. He received his ticket in 1969, like almost all New England aspiring hams, at the FCC office in Boston's Custom House Tower. "I loved those Ameco study manuals," said Jim. His first Rig? Ten Tec PM-3. "Then I had an HW-7 and an HW-9 but I sold everything 5 years ago to get my Elecraft K-1." A constant QRP experimenter, Jim has tried endless antenna and power projects: "I just have to try new ideas and there is more failure than success; and that's why I love QRP." Jim's hilltop antenna is also, like W1PID, a vertical wire: "I keep the 26 gauge counterpoise wire and the radiator on separate used empty plastic reels of white bandage tape." Thrifty!

While they share similar antenna design, the similarity ends there. K1JAW's K1 weighs more than W1PID's 3 ounce ATS3 and he carries solar cells, tables, batteries and more. Operating from his Honda CRV, Jim roams the New England and New York countryside, often while at work on his way to an appointment (he reluctantly admits maybe being late for the appointment once or twice), and operates at roadside overlooks. No hiking. No backpack. No trails.

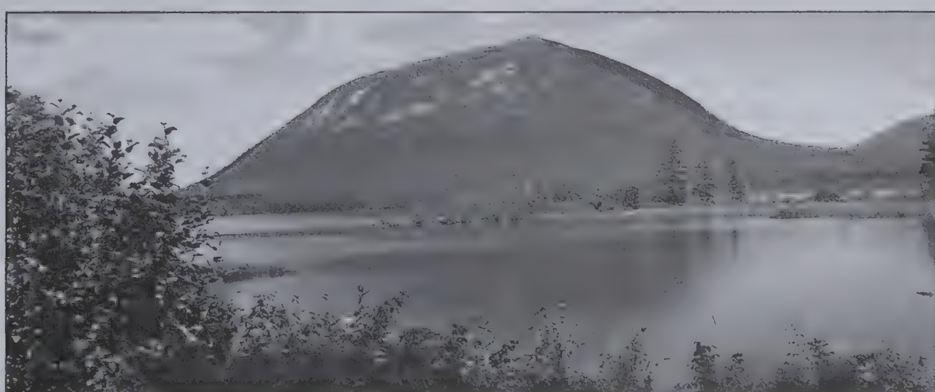
K1JAW's contacts are different too. "I'm a ragchewer. I want to know who I'm operating with. I like to learn about my fellow ham, learn about their day and what their current projects are." Being a conversationalist, probably explains Jim's choice of bands. "I often work 40 meters from 7025 to 7045."

Vacationing brings many hilltop opportunities for K1JAW. Most recently, Jim operated QRP from Arcadia National Park near Bar Harbor, Maine as well as Moosehead Lake/Mt. Katahdin area of Maine's inland forest. "I'm with the family, so I work 7-9 am every day. It's funny, even at that hour, people walk by our campsite and are curious. They ask me what I'm doing, so I drop everything and we have a chat. It's a great way to introduce people to the hobby, and just meet new people, period!"

Since Jim's contacts are longer, his battery power needs exceed W1PID as well. "I tried lightening up on the batteries, going down to a 1.5 AH gel cell, but it just didn't work. If I go under 7.5 AH I need really strong sunlight to run the panels and keep the power up. Otherwise, I need AC mains for recharging or I just have to muscle in the extra power with bigger and heavier batteries." It's a good thing Jim has room in his CRV for the gear. No ultralight backpacking going on with K1JAW !

Whether backpacking or driving, K1JAW and W1PID agree about the outdoors: It's refreshing, different, and it's fun. Better yet, getting that wire up 2000 feet on a hilltop sure beats muscling up that 100 ft monster tower in the backyard.

Happy Hilltop Operating, QRPers!



Moosehead Lake.

CactusCon — A New QRP Convention

John Stevens—K5IS jwsteven@concentric.net

Figure 1—The Fort Tuthill Campgrounds.

Figure 2—Preparing the picnic.

WoooHoooo! The first CactusCon is history and we had a great time—campers, visitors, guests, and tailgaters alike! This was the return of the Arizona ScQRPions to the Ft. Tuthill Park and campgrounds, where we actually started our activities and forums 12-15 years ago in conjunction with a much larger hamfest and the ARRL Arizona state convention. We had guests from as far away as Maine, Iowa, Colorado, New Mexico, Arizona, Utah, Idaho, and California this year. Texans don't believe there is anything West of El Paso except for horse racing at Ruidoso in the mountains of Southeastern NM…

The Fort Tuthill campgrounds were beautiful! There were lots of very tall Ponderosa Pines and plenty of room to spread out. You can see a picnic being prepared in the background (see Figure 1). Figure 2 shows some of the ladies preparing the "healthy" end of the buffet line for the picnic. The cakes, cookies, and other good stuff is out of view to the right. The entire table in true ham fashion was completely mowed down this year.

Fred, AA7BQ, of QRZ.COM surprised us with a visit on Friday to take a look at the CactusCon activities. He filmed interviews with a number of those in attendance and the first of these videos for viewing at the QRZ.COM website.

Figure 3 shows one corner of the large dining room for the Friday evening dinner out!

Attendance for the newly transplanted event was about 60 amateurs plus family members, as expected, and by most accounts it was a rousing success. The presentations at the forums were terrific. The meeting room at the hotel was packed for all sessions and it stayed that way all day long. Figure 4 shows only about 2/3 of the crowd in the forums meeting room. The internet audience was both domestic and international, approaching 200 viewers that were able to interact with the local audience and speakers. Video of the presentations will be available for viewing or download at the ScQRPion website.

Dr. Megacycle (Jim Duffey, KK6MC) gave a very interesting presentation on the KK6MC/5 collection of antennas normally mounted on his vehicle for "roving" in the VHF/UHF contests. In Figure 5 he is explaining his 222 MHz WA5VJB Cheap Yagi. These antennas are very inexpensive, quick to build, and perform VERY well. Look 'em up. You'll find many, many implementations of these antennas. Kent (WA5VJB) has dimensions for 2m through 1.2 GHz on his website. He even has one for HDTV! Figure 6 shows Jim's entire collection on the rover. He has everything from a 6m Moxon to Yagis on his rover.

Dan Tayloe (N7VE) was next, talking about active RC filters, filter design soft-

Figure 3—Friday night's dinner out. Facing us left to right are Vicki and Dan Tayloe (N7VE), Patsy and Jerry Haigwood (W5JH), the backs of Karl (K5DI), JoAnn and Doug Hendricks (KI6DS), and in the foreground Terry (WAØITP) and Bob (W9YA).

Figure 4—The crowd at the forum.

Figure 6—Antennas used on the KK6MC rover.

Figure 5—Dr. Megacycle holds forth.

Figure 7—Dan Tayloe, N7VE.

Figure 8—Chuck Penson, WA7ZZE.

ware, and their implementation in an upcoming low cost 80M transceiver kit (see Figure 7).

Then, Chuck Penson (WA7ZZE) made a very interesting presentation on the communications systems of the Titan ICBM complexes and much, much more. Chuck is the archivist for the Titan Missile Museum in Green Valley, Arizona. Their massive discone antenna is available for amateur use when you visit! (See Figure 8.)

Chuck was followed by Paul Harden (NA5N, Fig. 9), talking about the history and use of Morse code from telegraph line days, through the spark gap days, into modern times. Paul continued with an insider's tour of the National Radio Astronomy Observatory (VLA) near Soccoro, NM, including a new antenna array being designed and tested for the observatory. THIS one has amateur applications that you will be hearing about one day soon!

The next talk was given by Tom Katonak (no call... yet.), who spoke about some of the equipment used for wireline telegraph and early telephony. There were many, many questions and much interest following his presentation (Figure 10).

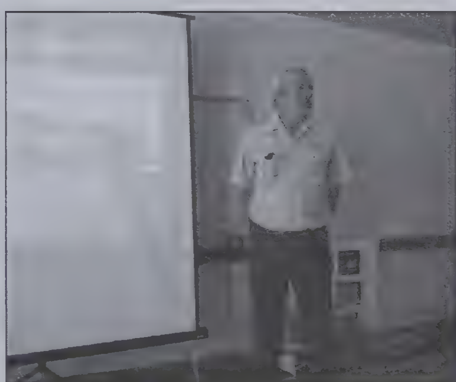


Figure 9—Paul Harden, NA5N.

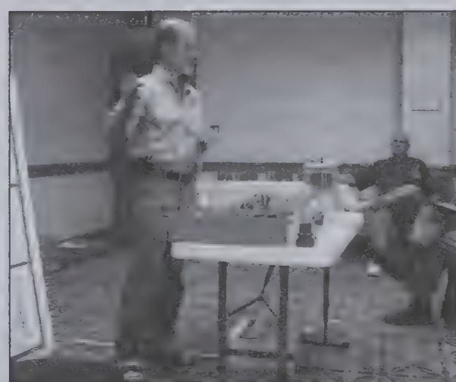


Figure 10—Tom Katonak talking about early equipment.

This was our first year on our own and indications are that we will be well beyond the capacity of our very nice meeting room next year. Plans are in the works to upgrade our facilities to accommodate an anticipated larger attendance in 2010. We hope that you will consider making plans to come join us in the cool mountains of Northern Arizona next summer!

VRX-1 — The Soul of a New Kit

Terry Fletcher—WAØITP and Jason Mildrum—NT7S

Part One, by WAØITP

As suggested by the title of a book I read way back in '81 (thank you Tracy Kidder). This article deals somewhat with bringing a design to the QRP community, in addition to describing the technical aspects of a new kit design.

Early this year (2009) Joe Porter, WØMQY and I were searching for another kit offering to add to the Four State QRP Group's kit lineup, and help fund OzarkCon 2009. So how does one begin a quest like this?

First we discussed what we would like add to the line of Four State kits. This included K8IQY Jim Kortge's excellent Enhanced Manhattan Islander audio amp, the innovative and high performance NS-40 Class E transmitter by Dave Cripe, NMØS, and the very successful HF Test Set by Wayne McFee, NB6M. It appeared to Joe and I, a receiver would be a good fit, so we pursued that avenue.

I began a search of well known designers and remembered Jason Milldrum, NT7S, winning QRP ARCI's first Quality Award. In 2007 he launched a very successful qrp-l.org group project build of his Willamette transceiver, which continued through the winter of 2008. His very nice potluck transceiver took first place in the Flying Pigs/QRP ARCI Potluck Homebrew contest at FDIM in 2007. So Jason was well known and obviously talented, in other words, a perfect person to ask for help.

A quick email or two and he kindly consented to contributing a project to the cause. It was originally crystal controlled 80M W1AW receiver. It is now a more complex receiver with a VXO, advanced mute circuit, and can be built for any band. In addition, it features Manhattan construction, easy quick, and allows for experimentation. The result is the Mark I Versatile Receiver. Talk about "feature creep." I was guilty of changing things on the fly and Jason was very magnanimous in accommodating the changes.

The VRX-1 is a simple yet versatile direct conversion receiver that employs some circuitry not commonly seen in the QRP kits currently on the market. The kit is shipped to be built as a VXO-tuned 40 meter receiver, although it can be reconfigured for different bands and types of tuning with a few parts from the junk box. The simplicity of the design lends itself to easy modification and experimentation. This kit is an inexpensive, solid performing direct conversion receiver that can be built for any of the 9 HF bands, 160M through 10M meters. Component values and modification instructions are included for each band of interest.

Like all designs there is a huge amount of work that must be done before the kit is announced on the email lists. The public doesn't see any of this of course, but it is the largest chunk of time in the whole process. Jason and I emailed many times concerning features, parts, design goals and performance, with much experimentation on both our benches.

One of those time consuming items is creating the assembly instructions, and I'd be remiss if I didn't mention Jason's excellent work here. He chose to make them a teaching document. The receiver is segmented into separate logical progressions with sanity checks at the end of each section to ensure that the receiver will work upon completion. Each section not only describes the construction, but also includes a write up of the functions of circuit being built. Check out the gray highlight boxes for design information and circuit function. The instructions are also a fine Manhattan building tutorial with plenty of pictures of component lead bending and gluing the pads. The great Arnie Coro CO2KK said they were among the best instructions he has seen.

Along the way to the birth of the VRX-1 there were many necessary and important distractions. Jason's job at Tektronix required many overtime hours in the spring and early summer. He also accepted a position as a part time technician at Buddipole. I was quite busy with other Four State activities, being deep into stuffing mailers, and selling kits. Another camouflaged item is the time it takes to process a kit order. Printing the labels, applying postage, filing the emails, answering questions, and mailing the kits is time consuming also. I visited with Doug Hendricks at CatusCon about it, and he estimates about 15 minutes per order. That seems about right in my experience too.

Additionally constructing web pages, trying to keep up with the grandkids, building some of my own projects, and coordinating with beta builders all compete for time. Also during that time Joe Porter, Keith Newman and I moved the location of OzarkCon to Branson, MO and did the conference in April. We both had much, much, task interference during this time.

Speaking of web pages, you'll notice many of the Four State kit pages look similar. Early on it was obvious to me that I couldn't afford the time to learn much HTML, CSS, etc. So the plan became to write simple code, keep plenty of examples to paste into new pages, and use as many templates as I could. I also found I could spend untold hours trying to make a page "perfect." I've come to the realization that perfectionism is a disease. During OzarkCon 2005 Jim Duffy, KK6MC, aka Dr. Megacycle, said that "Perfectionism is the enemy of progress." I've never forgotten it. Get'er done is my motto now.

In the "get'r done" category comes ordering and bagging parts. This is no small task, ask any kitting group. A large hurdle for me personally is the actual bagging process. I use a container for each part in the BOM, placing these around a table and loading them with the parts. A card with the schematic designation (R1, C6, Q1, etc), quantity, value, and supply house part number is placed in front of the container. That takes time, but the tough part is filling the bags. It takes intense concentration to avoid missing parts, or grabbing too many. Also required is a time commitment and Ibuprofen for an aching back due to bending over the containers. I'm highly indebted to Steve Miller, NØSM, and Neal Runkle, NØEAL, for jumping in and helping stuff the bags for many of the Four State kits. Without their able and amiable assistance I'd still be babbling in the basement.

Another item sometimes hidden from the public is the time, energy, and expertise of beta builders. The build the first examples from the kits, carefully follow the instructions a look for discrepancies. They

assess the overall function of the design in the user environment, and finally write a report on their findings. This is an important job and we're grateful to Steve Miller, NØSM, Rick Bennett, KCØPET, Tom Sevart N2UHC, and Dennis Smith, W5VAF for their efforts.

Now that you have glimpsed a little of what's behind the scenes, stay tuned for more Four State kit announcements. We have new kits in the pipeline that will compliment the existing product line, and will be valuable additions to any ham shack.

It's a labor of love but it's a good thing I'm retired, how did I ever find time to work?

Part Two, by NT7S: Project Origins

The VRX-1 Receiver kit can directly draw its lineage back to the last few projects that I've created and documented for the QRP community. What started out as a simple platform for privately testing some new circuit ideas ended up slowly transforming into a simple but unique receiver for general use. I'm a relative newcomer to the QRP kit designer ranks, but I suspect that this process happens more often than most folks realize.

It could be said that the genesis of many of the ideas found in the design choices and documentation of the VRX-1 can be traced back to my last big project: the Willamette direct conversion transceiver. The Willamette is a moderately complex, all discrete-component kit which was designed to be built Manhattan-style. In order to be as helpful as possible to new Manhattan builders, I created a detailed parts layout template to illustrate exactly where each component was placed and how it was oriented.

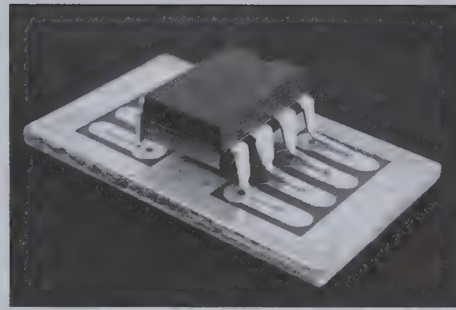
I created the kit, performed the kitting, and organized a group build on the qrp-l.org mailing list in 2008 in order to help encourage homebrewing in the QRP community. Although designing the circuit and writing the documentation took a significant amount of time, I also discovered the huge amount of work that goes into putting together even a modest kit run, especially because I foolishly set out to provide pre-punched Manhattan pads for each builder (175 per kit, to be exact).

While I believe that the Willamette project was mostly successful, in hindsight I found that there were a few aspects which weren't ideal. The biggest thing which bothered me was the complexity. I wanted to create a transceiver with many of the circuits that make operation enjoyable instead of a chore; things like RIT, solid-state T/R switching, a full 5 watt transmitter output (adjustable down to 0 watts), a nice sidetone, and a bulletproof mute circuit. Those features are great to have, but implementing them in an all-discrete transceiver takes a lot of components and circuit board space. The end result was a fairly full-featured rig, but one which could be daunting for the inexperienced builder to tackle. After the project wrapped up, the idea of creating a similar but much simpler project gnawed at me for quite a while.

This set the stage for the birth of the VRX-1. However, I can't say that I consciously decided on the end product when I started working on the circuits at the heart of the VRX-1. It's probably better to state that some fortuitous circumstances combined with the lessons learned from the Willamette to give rise to this kit.

First Iteration—80 Meter W1AW Receiver

Before the VRX-1 even was the VRX-1, I began experimenting with the circuits at the heart of the current receiver. Late in 2008, I was looking into some alternative mixer topologies that might be a bit easier to implement than the ubiquitous diode ring mixer. Armed with Experimental Methods in RF Design (the homebrewer's bible), I spotted a promising circuit on page 5.4. Here the authors describe a mixer design from Steve Maas using single FET, a capacitor, and an inductor [1]. This type of mixer has been used frequently in integrated circuits for microwave systems, but is definitely not in common use in the QRP world. A bit more investigation lead me to the web page of author Rick Campbell KK7B at Portland State University [2]. As part of one of his Introduction to Microwave Design classes, he published an LTSpice analysis of this mixer in an HF circuit. In this paper, KK7B compares the single-ended FET mixer to a diode-ring. He concludes that although the FET mixer is a bit noisier, it has a significantly better input intercept. The single-ended FET mixer is a narrow band circuit, but this also relieves the need for a broadband IF termination that a diode-ring requires. This circuit looked as though it might fit the bill.

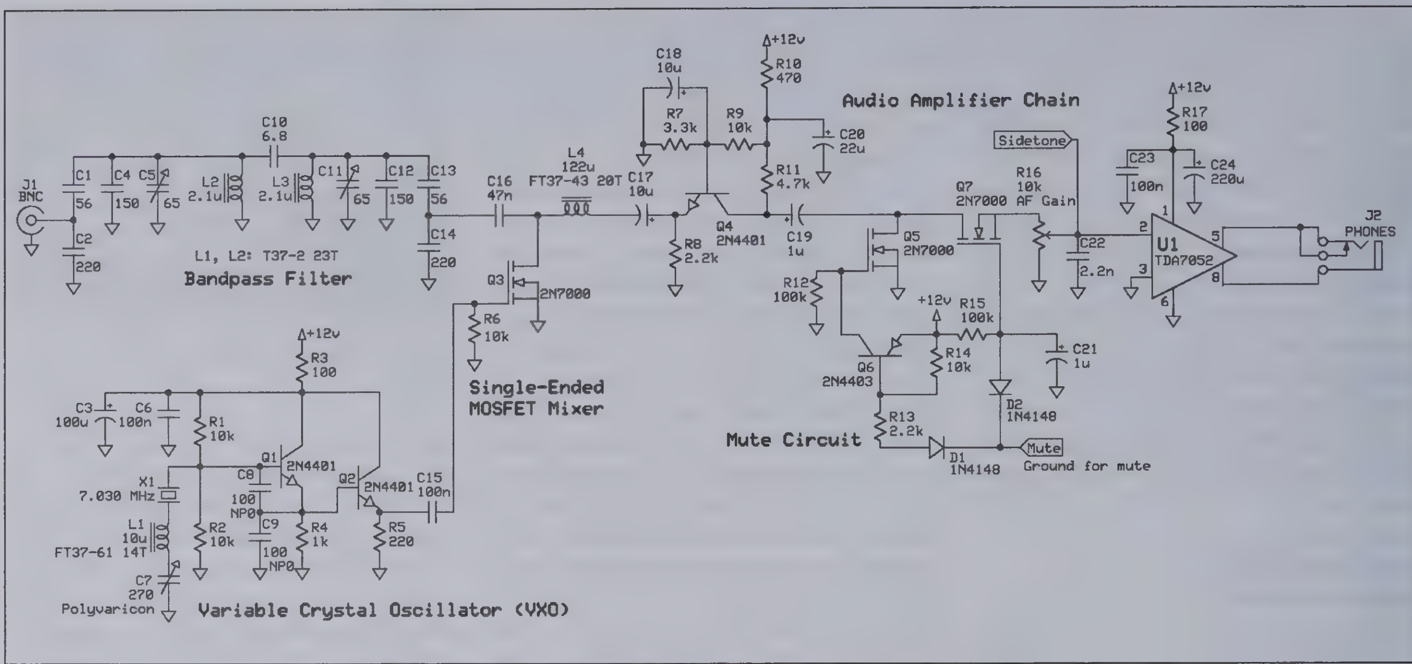


TDA7052 audio amp IC on its own "pad board."

The other main building block of the VRX-1 is the TDA7052 audio amplifier. I suspect most of you are well familiar with the LM386, along with all of its associated limitations. It's a fine IC for "popcorn" style receivers, but I'm sure most of you are as tired of it as I am. The idea of trying the TDA7052 came from one of the many mailing lists that I'm on, before the VRX-1 was in development (sorry, I don't recall which mailing list or who recommended it as a possible LM386 replacement). As is my usual custom, I purchased a handful of TDA7052 ICs in one of my Digi-Key parts replenishment orders, which then sat in my junkbox for quite a while.

The impetus for finally putting these elements together into a receiver came when I won an eBay auction for a very large batch of 3.582 MHz crystals. I thought it might be fun to create a "single-signal" direct conversion W1AW receiver, using a 3-element crystal ladder filter in the front end for selectivity (much like the PSK-80 Warbler). Using the crystal ladder design program in Experimental Methods in RF Design and some cookie-cutter circuit elements from other projects, I was able to pull off the W1AW receiver fairly easily. Instead of using a JFET for the mixer as shown in Experimental Methods in RF Design, I decided to try using a 2N7000 MOSFET. This is a nice cheap and easily sourced part, and one that I didn't have to gate bias, unlike the JFET. The simplicity and usefulness of the single-ended FET mixer was pretty impressive, and the TDA7052 sounded quite nice.

It was about this time that Terry Fletcher WAØITP contacted me about designing a kit for the Four State QRP Group. I put the W1AW receiver on the



Schematic of the VRX-1. Note the FET mixer circuit and audio amplifier chain decribed in the text.

table, even though I thought it might not have enough appeal to work as a kit. Terry agreed, and we both quickly came to the consensus that modifying the design to become more of a generic receiver might be a winner. This is when it really dawned on me that this would be a perfect opportunity to make that simple Manhattan kit for beginners that I've wanted to do since the Willamette project ended.

Second Iteration—40 Meter VXO Receiver

I got to work rethinking the design of the receiver, retaining the main circuit elements while making it more suitable for general use. Terry didn't put any strict guidelines on the work, although he suggested that creating a 40 meter VXO-tuned receiver to act as a companion to the NS-40 transmitter [3] might be a good idea. I thought that was an excellent plan, so that's where I took the design.

The simple crystal oscillator LO in the W1AW receiver was modified to work as a VXO by adding an inductor and a polyvaricon tuning capacitor in series with the crystal. The crystal filter in the front end was ripped out and a garden variety double-tuned circuit was put in its place to act as a front-end bandpass filter. I also thought it would be wise to add in a simple series 2N7000 mute circuit to allow the receiver to be used in conjunction with a transmitter.

It was pleasing that the new 40 meter receiver fired right up on the first build, as expected. The design process seemed almost too easy. I had the nagging feeling that I was missing something, but my preliminary testing showed a functional receiver. I thought that the receiver might need a few minor tweaks, but that it was pretty much ready for beta testing. Using my previous Willamette documentation as a template, I created build documentation and a layout diagram for the beta receiver.

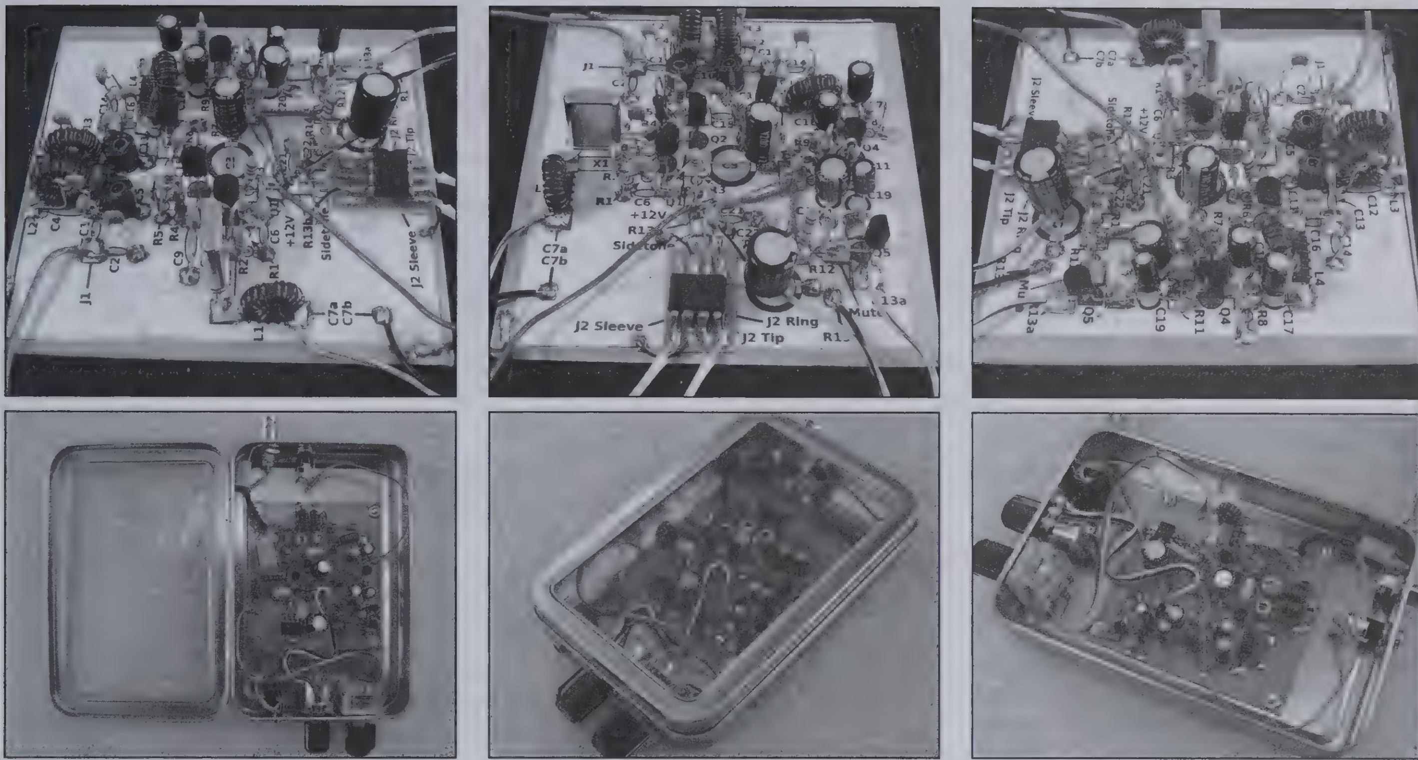
As you quickly learn as a designer, there's always going to be problems that the beta testers will find that you either completely missed or you never occurred to you. Even with a simple receiver like the VRX-1, I couldn't get away from these phenomena. The receiver did work for the beta testers as expected, but the mute circuit was nearly worthless. I'm still not sure how I didn't catch this in testing, but whenever the VRX-1 was connected together with a QRP transmitter using a T/R switch, the transmitted signal could still be heard very loudly in the headphones with the mute enabled. My simple mute circuit thrown in at the last minute, mostly as an afterthought, was a complete failure.

Third Iteration— Improved Mute and Station Integration

In order to get the VRX-1 to a state where it could be sold as a kit, I had to get the mute circuit rock-solid. I won't bore you with the details, but I tried numerous iterations of failed mute circuits. I had a solid mute design from the Willamette that took me a lot of work to get right, but I didn't initially want to use it because it meant adding on quite a few components and completely redesigning the layout of the Manhattan circuit board. So I tried to take shortcuts and wedge in some additional components into the existing space. None of them worked out.

I finally conceded defeat and went back to the design from the Willamette, one that I knew would work. If I were smart, I would have just done this from the beginning, but I wanted to be lazy and avoid a major redesign of the circuit layout. This was one of those mistakes that is obvious in hindsight, but the supposed time savings of avoiding a redesign made sense at the time.

One advantage of the redesigned mute circuit was the addition of a keyed VCC line. This gives a convenient place to get power if you want to add the optional Twin-T sidetone circuit. These might seem like minor features, but they make it much easier to integrate the VRX-1 into a complete station. Even though it was a huge pain, the mute circuit redesign was well worth it, and made the VRX-1 a much stronger product in the end.



Different views of the VRX board, and final assembly in an enclosure that should be familiar to most QRPers.

It's important to note that Terry was instrumental in immediately trying circuit changes on his beta receiver and giving me instant feedback on the results. Without his technical help, the project would have taken much longer to get off of the ground. Having a partner to help in this capacity was extremely critical.

Wrap-Up

Now armed with a solid product, only a bit more beta testing was necessary to make sure the receiver was functioning correctly, and would be something a bit more useful than a throwaway toy. Once that was confirmed, all that was left for me to do was to tweak the final documentation to incorporate any final suggestions from Terry and the beta builders. Terry handled the rest of the product roll out from this point.

A quick note about beta testers is in order. While every beta tester who completes their build successfully is useful, one who goes through the trouble of taking detailed notes and offers you suggestions on areas of improvement is like gold to you as a designer. Also, it's probably best to estimate how many beta builders you will need, then double that number.

One thing that I cannot stress enough for a prospective kit designer is the importance of keeping up on your documentation maintenance. You must be sure to stay on top of updating all of your documentation when you make changes, or you face a potential nightmare later on. This includes the schematic, bill of materials, any layout or parts placement diagrams and of course every reference in your main instructions. It's already very easy for errors to creep into your documentation; procrastinating makes it much easier.

A very intriguing aspect of the design and development of the VRX-1 was the communication channel between Terry and I. All of our communication was carried out via e-mail. We've never met in person, nor have we even spoken to each other over the phone! I know it's a bit of a cliché, but the advent of time-shifting communication over the Internet is a true wonder. Because of my work schedule and the time zone difference between the two of us, it would have been very difficult to try to handle our communications any other way.

I've taken away some important lessons from my first foray into kit designing for a QRP club. Fulfilling orders is a very small fraction of the work done when a club kits a project. There's an unbelievable amount of work behind the scenes that has to get done before a kit can come to market. The design has to be created, tweaked to meet the needs of users, then tweaked again and again until it's nearly perfect. Beta testers have to be gathered and a beta build (or two) have to be managed. Parts have to be sourced, production runs have to be estimated, capital to fund the project has to be obtained, and kits have to be kitted. Keep in mind that in most cases, very few or none of the people involved are making any money off of the effort, even though long hours are sometimes necessary.

Although it is a lot of work, it's also extremely gratifying to create a product that other folks will get to build and enjoy. Now if only I could find a job that would pay me full-time to do this!

References

1. Hayward, Wes, Campbell, Rick, and Larkin, Bob, *Experimental Methods in RF Design,* p 5.4

2. Campbell, Rick, "Passive FET Mixer Study," http://web.cecs.pdx.edu/~campbell/mixnotes.pdf

3. NS-40, http://www.wa0itp.com/ns40.html.

VHF QRP: What's in a Name?

Bob Witte—KØNR
bob@k0nr.com

Abbreviation	Name	Frequency Range	Wavelength	Ham Bands
ELF	Extremely Low Frequency	30 to 300 Hz	10000 to 1000 km	none
VF	Voice Frequency	300 to 3000 Hz	1000 to 100 km	none
VLF	Very-Low Frequency	3 to 30 kHz	100 to 10 km	none
LF	Low Frequency	30 to 300 kHz	10 to 1 km	*73 kHz, *136 kHz
MF	Medium Frequency	300 to 3000 kHz	1000 to 100 Meters	*500 kHz, 160M
HF	High Frequency	3 to 30 MHz	100 to 10 Meters	80M, 60M, 40M, 30M, 20M, 17M, 15M, 12M, 10M
VHF	Very-High-Frequency	30 to 300 MHz	10 to 1 Meters	6M, 2M, 1.25M
UHF	Ultra-High Frequency	300 to 3000 MHz	100 to 10 cm	70 cm, 33 cm, 23 cm, 12 cm
SHF	Super-High Frequency	3 to 30 GHz	10 to 1 cm	various
EHF	Extremely-High Frequency	30 to 300 GHz	1 to 0.1 cm	various

Notes:
**These LF and MF bands may not be available in all areas, or available only with an experimental license. Various bands in other frequency ranges may be allocated in some countries, e.g. 70 MHz.*

Recently, I've noticed that the term "VHF" gets used quite loosely, often meaning any amateur radio frequency above 50 MHz. I have tended to toss the term around that way, without much precision. When I write this VHF column that is how I think of it—any amateur band above 10 meters. Similarly, hams often refer to 10 meters and below as "HF." So the shorthand becomes: HF is 10M and lower while VHF is everything above that. While commonly used, it is not precise terminology.

Among FM-oriented radio amateurs, there is a tendency to refer to the 2 Meter band as VHF and the 430 MHz band as UHF. This apparently comes from the popularity of dual band VHF/UHF radios that cover the 144 MHz and 430 MHz bands, leading us to refer to those bands as "VHF" and "UHF" respectively.

This caused me to go back to basics and investigate the proper nomenclature for the various frequency ranges. I pulled out the Sixth Edition of *Reference Data for Radio Engineers* [1], one of those big, thick books that sit on the shelf filled with valuable information. This is a radio engineering book, not a ham radio book. The frequency band nomenclature is listed in the accompanying table. I also checked online and found that Wikipedia [2] agrees with these definitions.

I've listed both the frequency range and the wavelength in the table above. The formula that relates frequency and wavelength is:

$$\lambda = 3 \text{ x } 108 / f$$

where λ is the wavelength in meters, and f is the frequency in hertz.

Alternatively, with frequency in MHz, we can use this equation:

$$\lambda = 300 / f_{MHz}$$

Reviewing the table, we see that the frequency bands (HF, VHF, UHF, …) are defined to cover one decade of wavelength and frequency. When expressed in frequency, the leading digit is always a 3 (e.g., 3 kHz, 30 kHz, 300 kHz). The wavelength for a given band also spans one decade, with the leading digit being 1. The resulting definition of VHF is a wavelength within the range of 1 to 10 Meters.

Notice that this scheme lines up well with respect to the voice frequency range, which in communications work is generally taken as 300 Hz to 3 kHz.

Now let's take a look at how the amateur radio bands stack up against these definitions. The 160 meter band falls into the category of Medium Frequency or MF. As expected, the amateur bands from 80 meters through 10 meters fall into the High Frequency or HF range. The VHF range is defined as 30 to 300 MHz, which covers these amateur bands: 50 MHz (6 meter), 144 MHz (2 meter) and 222 MHz (1.25 meter). Although not a U.S. amateur band, some parts of the world also have the 70 MHz band. The UHF range includes the 430 MHz (70 cm) band as well as the 902 MHz (33 cm), 1240 MHz (23 cm) and 2300 MHz (12 cm) bands. The 3.3 GHz, 5.6 GHz, 10.0 GHz and 24 GHz bands are classified as SHF. Any frequency that is 30 GHz or higher generally falls into the EHF range. For the exact frequency range of each band, refer to the frequency chart at the ARRL web site [3] or consult your country's regulatory authority.

The naming scheme arbitrarily groups a decade of frequency together under one name. However, notice that the frequencies within each range tend to have common characteristics in terms of propagation. The HF range of frequencies follows the typical pattern of daylight/nighttime skywave propagation and is dependent on the 11-year solar cycle. The VHF range is made up of frequencies that are nominally "line of sight" but can experience longer distance propagation via tropospheric ducting and sporadic-E skip. (Sporadic-E is fairly common on 50 MHz, less so on 144 MHz and 222 MHz.) On the other hand, the UHF frequencies may also experience tropo ducting but hardly ever (never?) experience sporadic-E.

So back to the original question—to be precise, the term "VHF" refers only to the 6 Meter, 2 Meter and 1.25 Meter bands. Similarly, UHF means 430 MHz, 902 MHz, 1240 MHz and 2300 MHz. So VHF/UHF means the ham bands from 50 MHz up to 2300 MHz. Another common usage in ham radio circles is to say "VHF Plus," which means everything above 50 MHz. Maybe that is the simplest way to go.

What do you think? Drop me a note at bob@k0nr.com or stop by my blog at www.k0nr.com/blog.

—73, Bob KØNR

References

1. *Reference Data for Radio Engineers*, 6th Edition, Howard W. Sams & Co., 1981.

2. http://en.wikipedia.org/wiki/Radio_frequency

3. US Amateur Radio Bands, ARRL web site, http://www.arrl.org/FandES/field/regulations/Hambands_color.pdf

QRP Clubhouse

Timothy A. Stabler—WB9NLZ wb9nlz@yahoo.com

Greetings from Northwest Indiana. As I have told you in the past, my wife and I have been building a new home for the last 14 months. With this writing, we are still waiting to get in. But, hopefully by the time you are reading this, we will be there and my knee will have been replaced. I plan to do rehabilitation with CW on my KX1. I have been told I will have a lot of time to do things not requiring knee work.

I do want to apologize again to groups who got my "panic" email about having nothing for this column. Our phone line got moved to the new house and the internet on the phone line a week later. Neither worked and it took a few days and some "nice" phone calls to have everything finally wired in correctly after it was supposed to have been done a month earlier.

I did get a nice write up regarding CactusCon held by the Arizona ScQRPions. Because of its size, it is included as a separate article in this issue. Be sure and read the article, as CactusCon was a rousing success. I have heard nothing from LobsterCon or SalmonCon although I am sure they were well attended and full of fun. Maybe next year (hint, hint)???

I also got an email from Bill Orton, KC7JMI, who is looking for QRPers in the Washington state area to start up a HF net. If this is like other nets I read about, Bill might find himself with a much larger net than just one state. Send me a frequency and time and I might try contacting from Indiana.

Masscon

The first Massachusetts QRP convention will be held March 12-13, 2010, in Westford, Massachusetts. Expected to present are: Alison Parent, KB1GMX, a frequent contributor to QRP Quarterly and VHF-and-up enthusiast, Michael Rainey, AA1TJ, author of numerous home brew project papers, Bruce Beford, N1RX, and Dave Siegrist, NT1U, from the New England QRP Club, John Sexton, KO1H, QRP contester, Chuck Kitchin, N1TEV, known for his work on regenerative receiver circuits, and three QRP Hall of Fame members: Dave Benson, W1SWL, Joe Everhart, N2CX, and George Heron, N2APB. Finally, Nobel Prize Winning physicist Joseph H. Taylor, Jr., K1JT, will round out the general speaker roster.

In addition to the full day of seminars given Saturday, March 13th, a Friday evening meet-and-greet session will be held March 12th giving attendees a chance to meet the speakers, visit with vendors, and trade or show their own wares.

A banquet will be held (separate admission) Saturday evening featuring Steve Galchutt, WGØAT, the "old goat" himself talking about hiking the peaks of Colorado with his trusty pack goats Rooster and Peanut. Steve has also participated in a lightweight DXpedition to the Caribbean. His presentation will include movies from both kinds of adventures and featuring plenty of QRP action.

The Masachusetts QRP Convention is made possible by generous contributions from its premiere sponsors Buddipole Antennas, Inc., and PART of Westford, the Westford, Massachusetts amateur radio club who is hosting the event.

Tickets will go on sale in September 2009. Admission is $25 for Friday evening and the Saturday conference. The Saturday evening banquet is $40 per person. Tickets are on a first-come, first-serve basis and attendance may be limited.

For more information visit the MassCon web site at http://www.masscon.org or send mail to info@masscon.org.

The Flying Pigs QRP Club International

In August, the Flying Pigs QRP Club International turned ten years old. In that ten years we've issued about 2300 Flying Pig numbers, we've hosted about 100 "Run for the Bacon Sprints," assisted with numerous Build-A-Thon events at FDIM, operated a Field Day QRP contingent from Caesar Creek State Park in Waynesville Ohio every year, paid no dues, made no rules, and we've had a LOT of fun. The RFTB Sprint has been managed by Larry Makoski W2LJ for almost 10 years and he kicks off this event on the third Sunday night of the month, beginning at 9:00PM Eastern Time. Check out the Flying Pigs at http://www.fpqrp.com

G-QRP Club

I have been informed by Steve, GØFUW, that on October 24, the G-QRP Club will be holding their annual convention and hosting a buildathon using the "kit" that was so successful at FDIM. the Manhattan style Sudden Receiver. The Bath buildathon group (Steve Hartley, GØFUW; Mike Coombs, G3VTO; and Lewis Thomas G4YTN) will be available to assist George Dobbs, G3RJV, and other G-QARP Club members. Steve promises a write-up and pictures in time for the next column.

Midwest Homebrewers and QRP Group

The group participated in what might be a called a QRP weekend. Rex, W1REX, put out a challenge for other folks to get on the air during LobsterCon. The Homebrewers decided to operate most of the day that Saturday and call it "1DIJ" for "One day in July." (Fig. 1) The day happened to fall on regular get-together day for the Group that normally meets on the second Saturday of every other month. So

Figure 1—The "1DIJ" Gang. From left to right: Jim (KGØORD), Dar (W9HZC), Joe (KØNEB), Ray (N5SEZ), Brian (KMØY), Steve (WBØQQT), Christine (NØRIS), and Mike (W8MZ).

Figure 2—Some of our Bumblebee Operators: KD4MSR, K4LDI, W4BLB, KG4ARS, AD4S, AE4NY, and W4QO (minus KI4IXR).

Figure 3—Jim, W4QO, and Bobby, W4BLB, operating near the "Magic Rocks" during the Bumblebee event.

the day turned out pretty good with nine members, spouses and a couple other folk who happened by. The group initially met at the regular meeting place of Breadeaux Pizza and then headed for the park from which they normally operate.

Within minutes, antennas were popping up all over the place. There were a total of seven setups. Dar, W9HZC, had his K1 on the air using his end fed antenna with his MFJ tuner. Joe, KØNEB, was using his solar powered KX1 with a Buddy Pole. Brian, KM9Y, and Jim, KGØRD, had an Icom 703+ on the air with what had to be a full size 80m dipole strung between two enormous trees. Christina, NØRIS, provided antenna help and was busy learning what everyone was using a why. Ray, N5SEZ, sat in his little car using a mobile antenna. A good time was had by all and a vote was taken. It looks like the group will be back on the air for 1DIJ in 2010.

The Group again will be in charge of the building session at Ozarkcon 2010. The initial thing under consideration to build is a field strength meter. We will see in the Spring.

NoGA QRP Club

The North Georgia QRP Club is alive and well and in 2009 moved their meetings to the Shephard Center, the nations' largest nonprofit hospital focused on people with spinal cord injury and disease, acquired brain injury, multiple sclerosis, chronic pain and other neuromuscular problems. This is located just North of downtown Atlanta and the move is the courtesy of Scott Skiles, KD4MSR, a NoGAnut and Vice-President of the Center. Usually 20-30 people show up at the monthly meetings, held on the second Saturday at 10 AM. In addition to SSB and CW nets, the club is involved in most local hamfests with demos and displays with an occasional buildathon.

Periodically, members take to the field. This year involved two camping trips. In the Spring, about a dozen members and guests went to Devil's Fork State Park In Lake Jocassee, SC for a weekend of fun. Most recently, on the weekend of the Bumblebee Sprint, six members, assorted family members and guests camped for four nights at the Ft. Mountain State Park near Chadsworth, GA at an elevation of 3000 feet (Fig. 2). The folks camping at the next shelter wanted to know if we were tracking bears! (Fig. 3). In total, about 20 people attended some portion of the weekend event. A word or two about the State Park; the fort is not what is normally thought of as an enclosed fort but is a loosely organized 855' rock fence built by native Americans about 300-400 years ago. Further information can be found at: http://ngeorgia.com/ang/fortmountainstatepark. Everyone had a good time except for a couple radios which did not fare too well. Had the Club's NOGAPig kit, a power indicator and guard, been used there would have been no problems. The info on this clever little circuit can be found at: www.nfarl.org.

The station operating at the wall consisted of Bobbie, W4BLB, Nathan, KI4IRX and Jim, WS4QO. Things did not go well as first an inadequate time was allowed for setup and antenna hoisting. It was about 45 minutes into the contest before everything was ready to go only to find out that all batteries were not charged as thought. A 2m call to base resulted in John, AD4S, bringing another battery onto the site and it was found to also have low power. Jim walked back to the base to see about getting another but managed to get on the wrong trail on the way back. I guess the extra mile was "fun" with a 7AH battery. Although a lot of contacts were not made, the BBQ was great as was the birthday cake. Everyone there had a great time along with good food, thanks to Harold, KE6TI and his XYL. Further information and photos of this event can be had at: www.nogaqrp.org/activities/fortmountain2009/indes.html.

Austin Amateur Radio Club

On Field Day, club members along with some of the AQRP members did some alternative power bonus contacts with QRP and solar charged batteries. The rig used was driving either a ground plane Minuteman vertical or an inverted Double Extended Zepp (IDEZ) doublet on a 40 foot military mast from the Red Cross Chapter lawn in Austin, TX. Bands used included 20m and 40m. In spite of the poor solar conditions, contacts ranged all around the compass throughout most of Field Day with no seeming pattern for either band used. Often the group finds early contacts with the East Coast then moving westward as the day progresses. Not this year. There did not seem to be many strong signals although if it was heard, it could be worked. Not many Caribbean stations were found on 20m although scarce states like South Dakota were worked. Field Day again made everyone wonder if all that RF firing in the same 24 hour period enhances propagation on its own.

Guess that is about I have for now. Please keep me in mind about your group and your doings. Send write-ups, pictures (with captions please) and anything else for the next column. It will be due in about two months. For those of you going, I will see you at Masscon and, or course, Ozarkcon.

—72, Tim WB9NLZ

Indiana Bumblebee 2009

Dan Caesar—NI9Y
ni9y@arrl.net

Dan, NI9Y

Barry, WD4MSN

Steve, KB9GP

Ken, WA9S

Bob, KB9IVA

Our Adventure Radio group started out a few years ago as a way to just have fun operating portable in unique places. As it turned out another goal was to encourage the South Bend, Indiana, Michiana Amateur Radio Club, W9AB, members to participate in activities away from their home stations. W9AB is one of the oldest radio clubs in the nation. Several of our past members, now SK, actually met Marconi when he came to the University of Notre Dame in the early years of radio to demonstrate communication techniques.

Barry, WD4MSN contacted the QRP-ers in the club to become bumblebees. So we got our bumblebee numbers and decided to operate on Leeper Park, Island Park, in the middle of the St. Joseph River in South Bend. So we all gathered our gear and portable antennas and headed out for the island which also was also designated as an official USA Island. I think the most fun was to see who could erect the better antenna. I used a borrowed Par-Electronics end-fed 40-20-10 meter Zepp. WA9S built an Iditarod multi-band dipole and Steve, KB9GP now ND9O, erected a 20 meter vertical with four elevated radials. Barry, WD4MSM, carried in his Bud Pole dipole. Bob, KB9IVA, used his MP-1 vertical mounted on a tripod.

I was amazed how well the end-fed Zepp worked. The end was only 20 feet in the air over an Oak Tree branch and the bottom was at ground level. No tuner was necessary as the antenna was 1:1 on all three bands. I mostly operated my favorite band 40 meters with my Kenwood TS-50S and a 40 pound gel cell. This was the easiest portable antenna I have ever put up in the air. It was a snap to just toss a lead fishing weight over the branch and pull the end up in the air and tie off the antenna rope. Since then I purchased a HB-1A Mark II three band QRP transceiver to use on our future Adventure Radio treks. No more 40 pound Gel Cell battery to manhandle. And I am planning to use a homebrew end-fed Zepp antenna next time.

Steve, KB9GP, lugged his home station Ten-Tec Pegasus and laptop and a riding mower battery. As it turned out the battery was not fully charged. Fortunately I keep a jump starter battery in the trunk of my car for emergencies. So Steve was able to fire up the Pegasus.

Ken, WA9S, used a borrowed Elecraft KX-1. What a neat pocket QRP radio with a built in antenna tuner. However Ken had to QSY to his Yaesu FT-100 because of QRM interference from the other stations. He used a small motorcycle lead acid battery for power. Ken's Iditarod antenna required 130 feet so he had to support the center and two ends in the tall Oak trees. Then he had to lower the antenna down to change bands. But he enjoyed the logistical difficulty of such a large wire antenna.

Bob, KB9IVA, had an ICOM-703 and two "C" cell battery packs wired in parallel for power. Since the 703 had a built in antenna tuner it was a snap for him to quickly QSY around the bands.

Barry, WD4MSM, also had an ICOM-703 but used a Bud Pole horizontal dipole mounted on a tripod. He positioned the antenna in a 45 degree angle next to the water's edge. He said the antenna seemed to work much better on an angle.

We all had the most fun just trying to make contacts. It was not our goal to see who could make the most contacts but to just enjoy the fellowship and setting up portable stations.

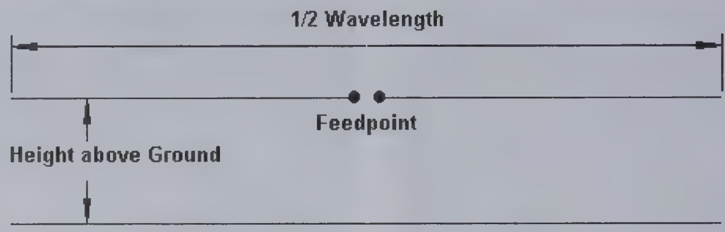
Our last QRP Adventure Radio event was the Lighthouse Weekend on August 15th. But that's another story. Well that's just about it for now. Hope to hear fellow QRP-ers on the air in the near future.

—73s Dan, NI9Y

My Top 5 Backyard Multiband Wire Antennas

L.B. Cebik—W4RNL (SK)

This article first appeared in the Proceedings of the 2004 FDIM.



The 1/2 Wavelength Resonant Dipole

Fig. 1

2004 marks my fifth full decade as a licensed radio amateur. So my offering to FDIM 9 will also be a matter of 5: my personal selection of the top 5 HF wire antennas for the backyard and for multi-band operation. Being a personal selection, there is no reason why your list should not be different from mine.

But, along the way, I shall explain why I selected the 5 antenna types that I am including, giving you my views on both their advantages and their limitations. My list is simple and in no particular order.

1. The broadside doublet(s)
2. The dipole-doublet(s)
3. Fanned dipoles
4. The hohpl—horizontally oriented and polarized loop
5. The inverted-L

In order to make sense of what we say about each type of antenna, we need a point of reference. Since virtually all of the antennas will be horizontal, the logical baseline to use for comparisons is the resonant 1/2-wavelength dipole. So let's review its characteristics.

The 1/2-Wavelength Center-Fed Resonant Dipole

The antenna that we loosely call the dipole is actually a 1/2-wavelength center-fed resonant or nearly resonant dipole. We usually construct it from AWG #14 or #12 copper or copperweld wire for the lower HF bands, and we may use bare or insulated wire. Often, we mislabel multi-band doublets as dipoles because the antenna is about 1/2-wavelength at the lowest frequency of operation. But to be strictly correct, that antenna is a dipole only at the lowest frequency of use. Fig. 1 shows the two essential dimensions of a real dipole.

Since we tend to feed the dipole with coaxial cable, we are concerned with the antenna length and resonance. In other words, we want a good match between the coax and the antenna feedpoint.

However, we also need to be equally if not more concerned with the antenna's height above ground. The old adage, "The higher, the better," arose from the use of wire antennas on the lower HF bands, where we generally could not achieve even a height of 1 wavelength.

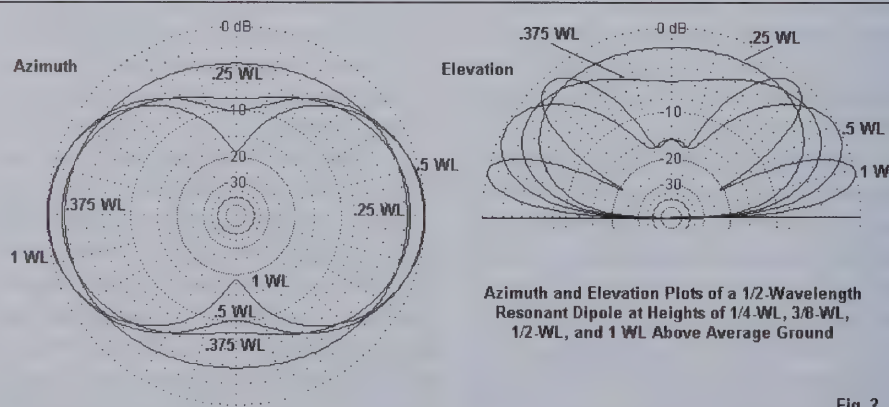
Table 1 serves as a reminder of how long a wavelength is on each of the HF amateur bands. For most backyard antennas, the average ham is lucky to achieve an antenna height of 1 wavelength on 10 meters, while the truly fortunate operator may get his wire to 1 wavelength on 17 or 20 meters.

Every horizontal antenna is subject to essentially the same general phenomena that affect horizontal dipoles in terms of their height above ground. The lower the antenna as a fraction of a wavelength, the lower will be the overall gain and the higher the elevation angle of the radiation. Fig. 2 illustrates the principle for a dipole placed at 1/4, 3/8, 1/2, and 1 wavelength above average ground. Unlike vertical monopoles, horizontal wires do not change their gain or elevation angle significantly with changes in soil quality.

The elevation plots on the right show that the lower we place a dipole, the higher the angle of radiation, a fact that limits our effective range of communications under normal propagation conditions. The azimuth patterns on the left not only show the reduction of gain with a reduction in height, but as well the change in pattern shape. As we reduce the height of a dipole, its figure-8 shape at 1-wavelength devolves into a simple oval at a height of 1/4-wavelength. What applies to the dipole will generally (but not without some exceptions) apply to any horizontal wire antenna rela-

Table 1. Approximate Lengths of a Wave in Feet

Band meters	Frequency MHz	Length feet	Band meters	Frequency MHz	Length feet
160	1.8	546	20	14.0	70
80	3.6	273	17	18.1	54
75	3.9	252	15	21.0	47
60	5.37	183	12	24.95	39.5
40	7.0	140.5	10	28	35
30	10.1	97.5			



Azimuth and Elevation Plots of a 1/2-Wavelength Resonant Dipole at Heights of 1/4-WL, 3/8-WL, 1/2-WL, and 1 WL Above Average Ground

Fig. 2

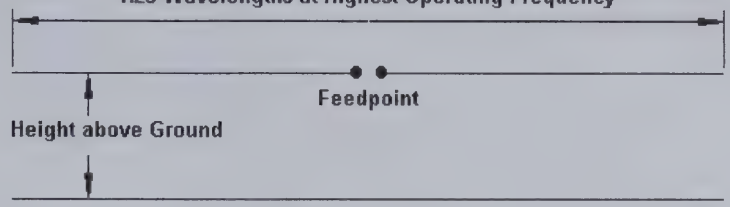
tive to its height above ground at the frequency of operation. When it comes to height, think wavelengths, not feet!

1/2-wavelength resonant center-fed dipoles have many other interesting characteristics, but the ones that we have noted will guide us while we explore the top 5 multi-band backyard wire antennas. We shall also be setting aside our coaxial cable in favor of parallel feedline to an antenna tuner (ATU) or, as some British writers prefer, an antenna system tuning unit (ASTU). Consider the ATU to be a lifetime investment.

1. The Broadside Doublet(s)

The broadside doublet is a simple multi-band doublet with a 4:1 frequency range for the desired characteristic. Fig. 3 shows the general outline.

In principle, the doublet is physically no different from a dipole. However, electrically, it is significantly different. First, we feed it with parallel transmission line to an antenna tuner, because the feedpoint impedance varies greatly as we change operating frequencies from one band to the next. Second, we select the length so that the antenna will show a bi-directional pattern broadside to the wire on all of the bands included. Note that the length makes the antenna an extended double Zepp at the highest frequency. With an antenna tuner, the antenna will operate above its highest included frequency, but the pattern will break up into multiple lobes.



The Broadside Doublet

Fig. 3

Table 2. Broadside Doublet Lengths and Amateur Band Coverage

Length (feet)	Bands covered
44'	10, 12, 15, 17, 20, 30, 40 meters
66'	15, 17, 20, 30, 40, 60 meters
88'	20, 30, 40, 60, 80 meters

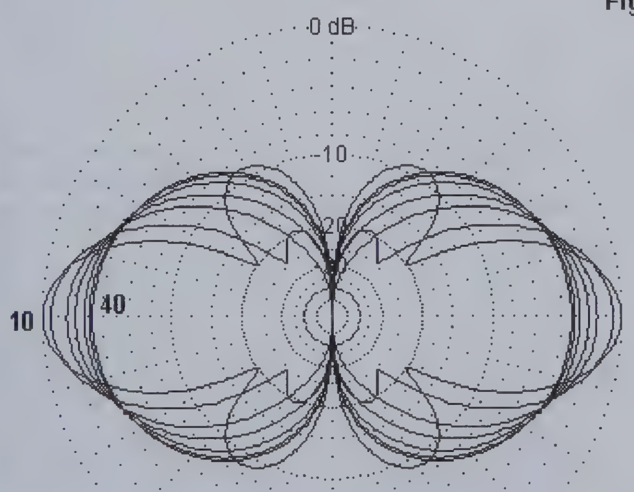
The chief advantage of the broadside doublet is that you always know the directions of your radiation or your most sensitive reception. A second advantage is the antenna's simplicity for a 4:1 frequency range with the bi-directional characteristic. A third advantage, which we shall note shortly, is the flexibility of the antenna in forming wire arrays having different characteristics.

With every set of advantages come one or more disadvantages. First, the antenna requires a wide-range ATU, since the impedance varies greatly from band to band. Since the exact values that will appear at the tuner terminals will vary with both the antenna height and the length and characteristic impedance of the parallel transmission line, I shall not provide specific numbers.

Second, the gain goes down with frequency. The broadside doublet has its highest gain at the highest frequency. The gain drops a bit with each move to a lower band, while the pattern broadens. Fig. 4 shows the patterns overlapped in free-space models. However, remember that as we go down in frequency, the antenna will have a height that is a smaller fraction of a wavelength. Hence—like the dipole—we can expect a further reduction in gain and a more significant increase in the elevation angle of maximum radiation. Hence, the higher you can place the antenna, the better will be its performance.

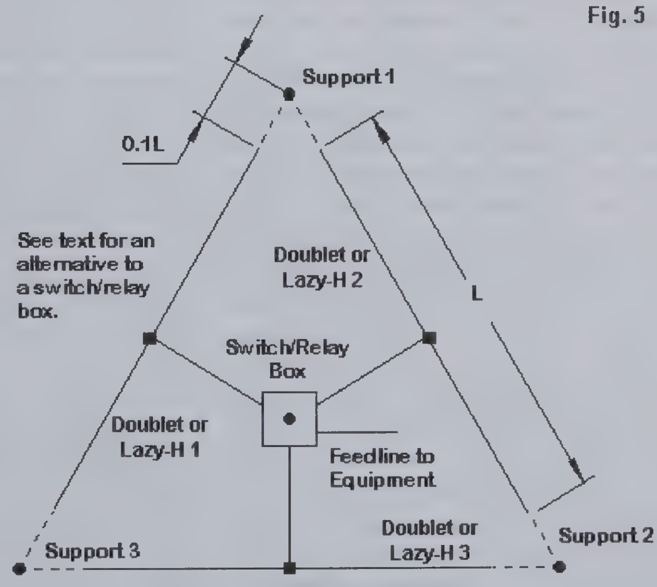
Part of the flexibility of the broadside

Fig. 4



44' Broadside Doublet in Free Space
Changes in Pattern Shape and Strength

Fig. 5



A Triangle of Broadside Doublets or Lazy-Hs
for Full Horizon Coverage

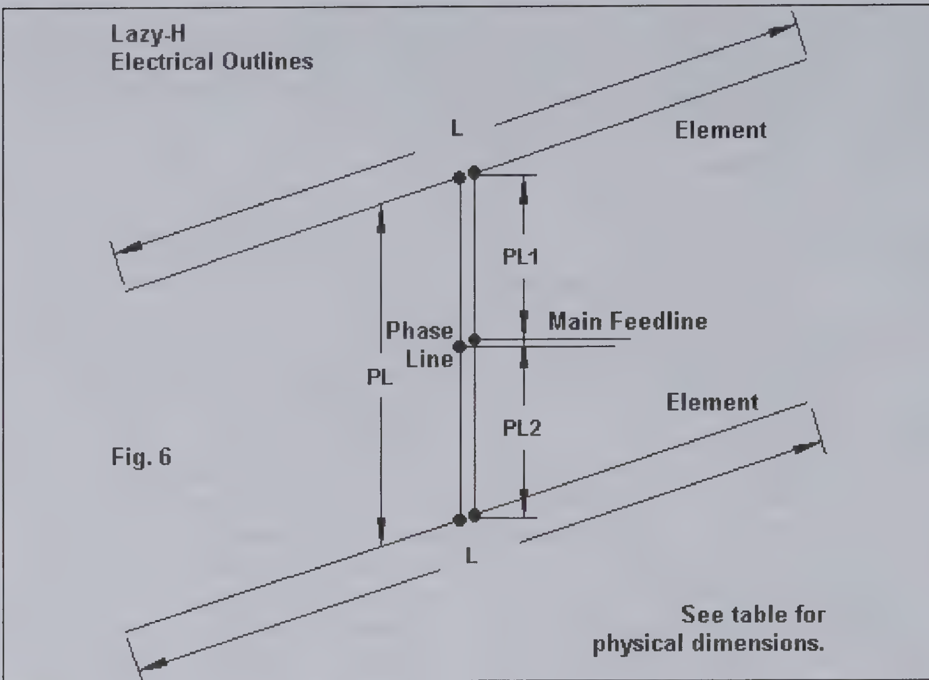


Fig. 6

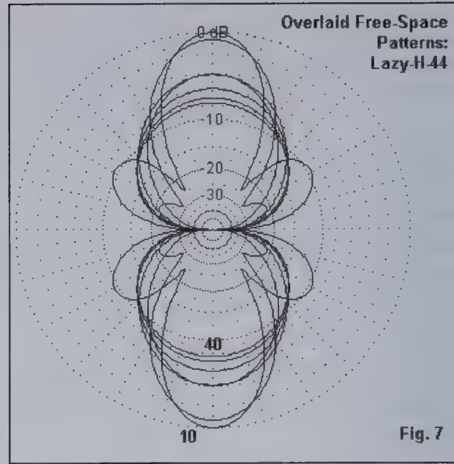


Fig. 7

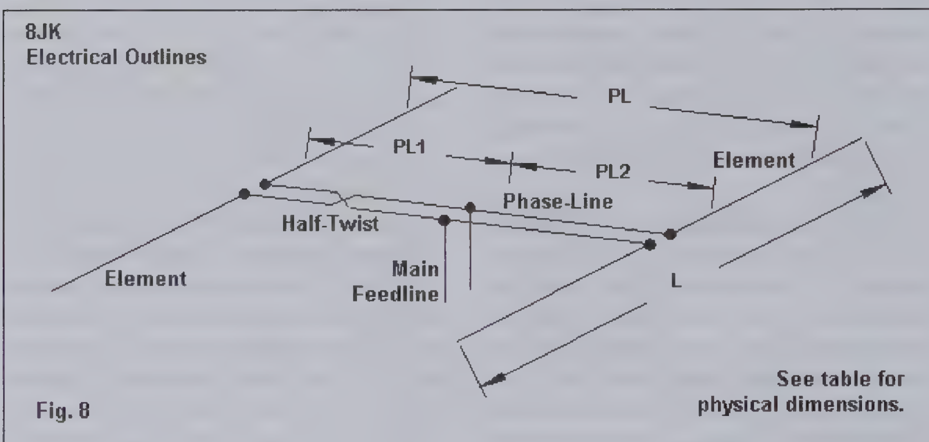


Fig. 8

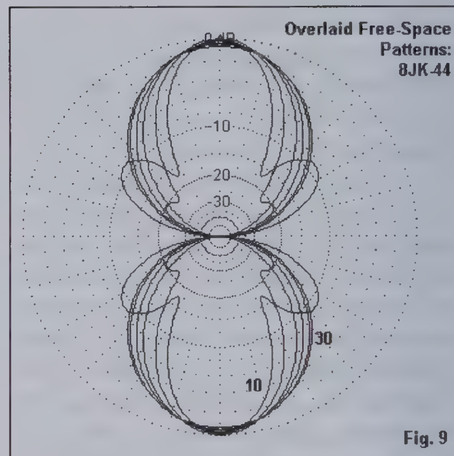


Fig. 9

doublet stems from the ease of covering the full horizon by adding only one more support. See Fig. 5.

We can easily form a triangle of doublets. The triangle need not be perfect, so you can adjust it to aim more exactly at your favorite communications targets. With only a bit of end space (about 10% of the wire length), the inert wires will not materially affect the operation of the one in use. The only caution that you need to observe is to keep the feedline lengths identical. This caution applies whether you use a fancy switching box at the center of the array or whether you bring three separate and well-spaced lines to the shack entry point and do your switching indoors. Equal line lengths will mean that you do not have to do major retuning when switching from one antenna to the other. Hence, you can easily determine the most effective antenna for an incoming signal just by switching through the 3 antennas.

Note that the triangle refers to either doublets or lazy-H antennas. That is part of the flexibility of the broadside doublet system. We can make lazy-H arrays using any of the listed element lengths and cover the same set of bands—but with more gain. Fig. 6 the outlines of a lazy-H.

The lazy-H is simply 2 broadside doublets fed in phase. We need the center main feed point to ensure that the lines to both wires are the same length and therefore give us the same current magnitude and phase angle at both element feedpoints. So PL1 and PL2 are 1/2 of PL. The total length of the phase line assembly can be longer than the spacing, but for most installations, they are the same. The ideal spacing is 1/2 of L, the element length. Hence, the spacing is 5/8-wavelength at the frequency where the element is 1.25 wavelengths. This spacing provides maximum gain. You can reduce the spacing somewhat, but every reduction reduces the gain on all bands.

The ideal lazy-H will net you almost 3-dB gain on the highest bands. There will be a slight reduction for the lowest bands, since the spacing will no longer be optimal. As well, the lower wire gets closer to the ground as a fraction of a wavelength when we reduce the frequency. Fig. 7 shows the overlaid free-space patterns to give you a basic idea of what happens to shape and strength, but remember to modify your expectations depending upon the height that you place the antenna. Getting the lowest wire at least 1/2-wavelength above ground is best, although lower heights for that wire will work. However, if that wire will be under 1/4-wavelength above ground, you may be better off with a simple broadside doublet at the upper level. It will give you a lower radiation angle than the pair of wires. As a side note, in any set of in-phase fed antennas—whether doublets, Yagis, or whatever—the effective height of the combination will be a point about 2/3 the distance between the lowest and the highest antennas. Of course,

Table 3. Lazy-H and 8JK Dimensions

Element Length (L, feet)	Phase-Line Length (PL, feet)	Bands covered (meters) Lazy-H	8JK
44'	22'	10 - 40	10 - 30
66'	33'	15 - 60	15 - 40
88'	44'	20 - 80	20 - 60

we can make a triangle of lazy-Hs, just as we can for the basic doublet.

There is a second multi-band array that we can make from the broadside doublet: an 8JK. See Fig. 8 for the outline. Developed by John Kraus, W8JK, in the 1930s, the antenna has undergone many variations. The versions shown here is designed for a 3:1 frequency range. It uses the broadside doublet lengths for the highest frequency, along with a total phase-line length that is 1/2 of the element length, L. However, note that when we create this end-fire array, we give one (and only one) of the phase line sections a half twist.

The specific dimensions we have chosen from W8JK's work are ones that give us an interesting pattern of gain, as shown in the free-space patterns of Fig. 9. The free-space gains are about equal on all bands. Indeed, the only factor that limits our frequency coverage is a very low impedance below the listed frequency limit.

Of course, over ground, the gain will decrease as we lower the frequency, since the array will be lower as a fraction of a wavelength. Within the included bands, the gain will be much more equal from band to band than with the lazy-H. However, the peak gain will not be as high at the highest covered bands.

We may summarize the array dimensions in a simple table (Table 3). Remember that since we are using parallel feedline and an antenna tuner, broadside doublet lengths are not finicky. However, in the arrays, strive for equal lengths for each element.

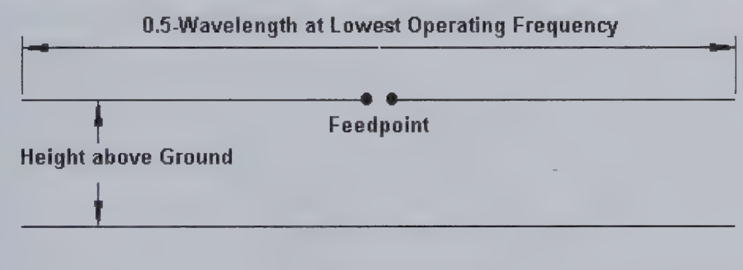


Fig. 10

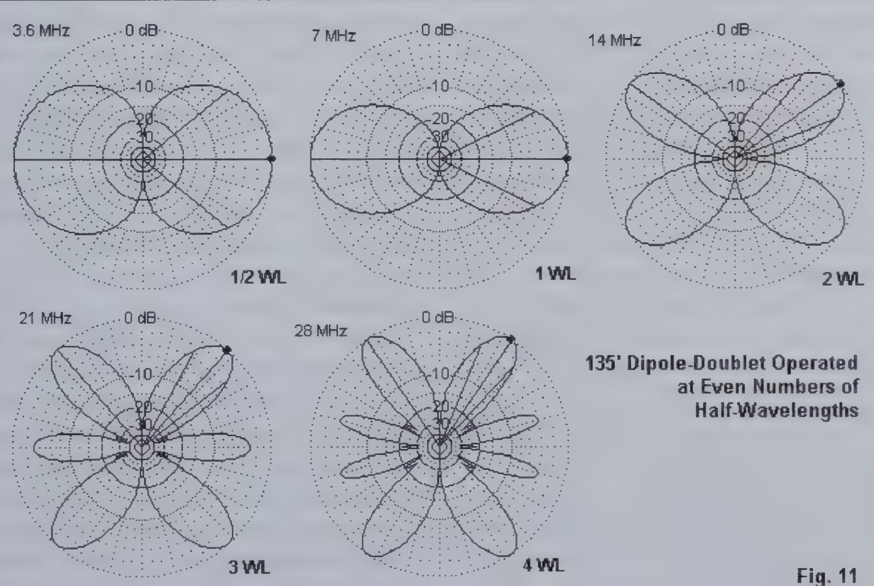


Fig. 11

2. The Dipole-Doublet(s)

The dipole-doublets differ from the broadside doublets in two respects. First, rather than determining their length based on the highest frequency of use, we determine it based on the lowest frequency. In most cases, the doublet is a 1/2-wavelength dipole (approximately) at the lowest frequency. (Even the G5RV doublet is a dipole on 60 meters.) Again, since we shall use parallel feedline and an ATU, we do not have to be finicky in setting the exact length.

Second, we do not give any preliminary thought to the lobe structure of the radiation pattern when we set up a dipole-doublet. Usually, we know that the pattern is bi-directional at the lowest frequency. However, we often do not think about the pattern above that frequency. As we shall see, the bi-directional patterns holds true until the antenna length as measured in wavelengths is greater than about 1.25. However, for many users, the patterns for the higher bands are mysterious.

To get us started, Fig. 10 outlines the basic dipole-doublet. It chief advantages are simplicity and the ability to cover all of the HF bands above the frequency for which the wire is a 1/2-wavelength dipole. Hence, the preferred lengths are usually about 260' for 160-meter coverage, 135' for 80-meter coverage, and 67' for coverage down to 40 meters. As noted, the G5RV 102' doublet manages to be a dipole at 60 meters. The 67' length will load on 60 meters, and the G5RV will load on 80 meters. In each case, the wire is about 1/3-wavelength, close to the limit for a center-fed wire. Below that length, the resistive part of the impedance goes too low and the capacitive reactance goes too high for most parallel line and tuner combinations to handle.

To start the process of becoming familiar with the typical patterns of a dipole doublet, examine Fig. 11. The dipole-doublet's length in feet matters less than how long the doublet is at a given operating frequency in terms of half-wavelengths. When the length is close to an even number of half-wavelengths, we have as many lobes as we do half-wavelengths. The strongest lobe moves farther from a broad-

side direction as we increase frequency. As well, the beamwidth of the strongest lobe becomes narrower. Because the ham-band operating frequencies do not result in exact multiples of a half-wavelength, the lobe strengths will vary. But the count remains true.

If we operate the same antenna at odd multiples of a half-wavelength, we obtain patterns composed of both emerging lobes and diminishing lobes. So the number of lobes is the sum of the old even number of half-wavelengths and the new even number of half wavelengths. In other words, we have twice the number of lobes as we do the length in half-wavelengths. See Fig. 12. Again, because the nearest ham-band frequencies are not precisely the number of half-wavelengths listed, we find some of the lobes weaker than others. However, the count remains true.

The patterns would change if we used a 102' or a 67' doublet when referenced to specific frequencies. However, relative to the frequency at which the doublet is 1/2-wavelength long, the patterns would re-emerge as shown as the antenna approaches lengths of 1 wavelength, 3/2 wavelengths, 2 wavelengths, etc. In addition, the dipole-doublet is subject to the same rules relating antenna height as a fraction of a wavelength to radiation elevation angles that we discovered for the resonant dipole.

If we understand the pattern development of a dipole-doublet, we can successfully use it without disappointments. The feedpoint impedance will vary over a wide range. In fact, it will be very high whenever the doublet is a multiple of a full wavelength. Hence, many users prefer 600-800-Ohm ladder line so that the line is an intermediate impedance between the highest and lowest values encountered.

I like the old dipole-doublets for their simplicity and their long tradition of successful use. They are also flexible. We can set up a triangle of them, but the complex patterns may not give us the full horizon coverage of the triangle of broadside doublets. There is even an old (1930s) trick that we can use with the dipole-doublet: the center-support Y. Fig. 13 shows the general outlines. The sketch shows 67' legs, comparable to a 135' doublet. However, you can use 50' or 35' legs with reduced low band coverage.

The Y-doublet's special feature is the use of a non-conductive center support (which may be no support at all if you can devise a way to hang the center freely). Either by spacing wires from a center pole or using triangular spacers, we bring down 3 wires, one from the inner end of each leg. The downwires form the parallel transmission line. At the shack entry point, we set up a switching system to select the pair of wires to form the transmission line for the active doublet. In most cases, it will not matter whether the third wire simply floats or is grounded: it is centered between the 2 active wires and has almost no current on it.

The Y-doublets form 120-degree angles. This angle makes almost no difference in the pattern relative to a linear doublet. There will be some differences in the patterns on the upper bands compared to those we saw for the linear doublet. Nevertheless, you will use an A-B-C switch to determine which pair of legs provides strongest signal. In order to make radical re-tuning unnecessary, it is important to keep the transmission line wires equally spaced in a triangle all the way to the switch at the shack entry point. The Y-doublet is one way to overcome some of the limitations of the dipole-doublet's multiple lobes on the upper HF bands.

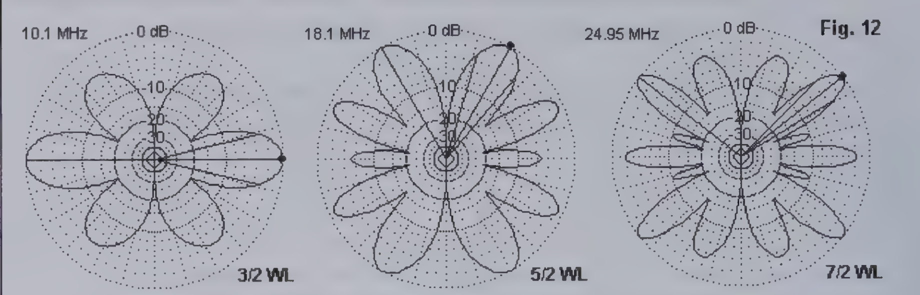
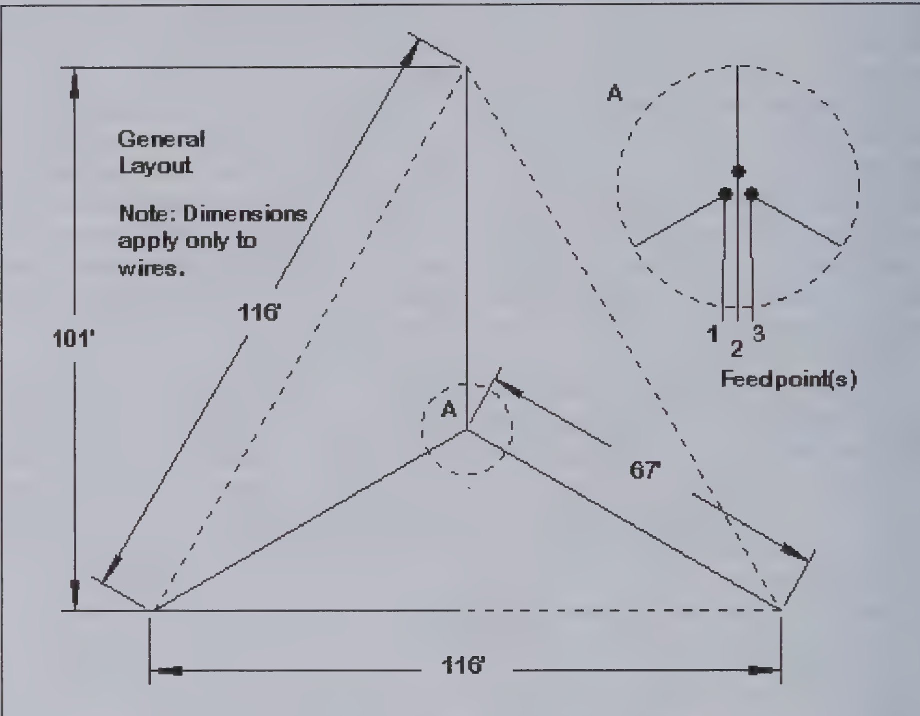


Fig. 12

135' Dipole-Doublet Operated at Odd Numbers of Half-Wavelengths



General Outlines of a Y-Doublet System

Fig. 13

3. Fanned Dipole

For coax lovers, my third selection for a multi-band antenna is fanned dipoles. I have seen a myriad of designs for these antennas, some of which include up to five or 6 bands and fold the longest elements into spaghetti. These designs I do not prefer, because they have very narrow operating bandwidths and erratic patterns due to combining long and short elements that

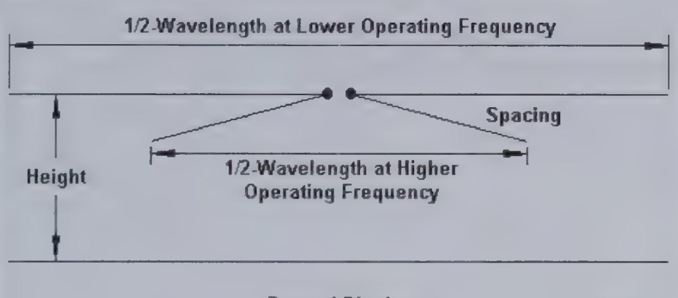
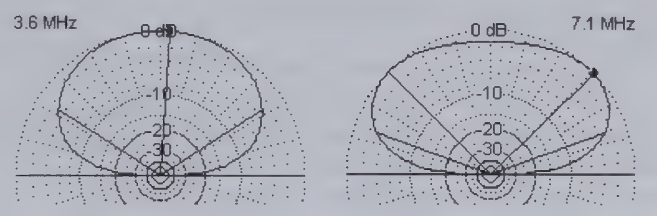


Fig. 14



Elevation Patterns of 80-40-Meter Fannned Dipoles at a Height of 50' Above Average Ground

Fig. 15

both offer low feedpoint impedances. For reliable service with decent bandwidths, I prefer to construct my fanned dipoles a couple of bands at a time so that when one band shows a low impedance, the impedance of the other band is high. As well I prefer to widely space the shorter element outer ends from the longer element and obtain a wider operating bandwidth on both bands. In short, my preference in fanned dipoles is a 2-band antenna, although I would not rule out a 3-band combination. Fig. 14 shows the general outlines with the critical dimensions noted. Ordinarily, we support the outer ends of the longer dipole and suspend the shorter dipole beneath.

Let's get a handhold on the properties of fanned dipoles with a simple 80-40-meter combination. We shall look at two versions of the same antenna. One will droop the 40-meter dipole 10' below the 80-meter dipole. The other design will place the 40-meter outer ends 1' below the low-band dipole. The 80- meter dipole is set for 3.6 MHz, while the 40-meter dipole is set for 7.1 MHz. Table 4 gives us the dimensions and the performance of the array on each band with the 80-meter dipole 50' above average ground.

Although there is no significant difference in performance at the two design frequencies between the wide and the close dipoles, we certainly can see a difference in the length of the 40-meter dipole. The wide-spaced version shows a length that approximates the length of an independent 40-meter dipole. However, the close-spaced version requires a much longer 40-meter element. Remember that the close spacing is still 1', which is wider than some published and commercial designs.

Fig. 15 shows the elevation patterns for the two bands. Like all horizontal antennas at low heights, neither pattern is ideal. The antenna on 80 meters is below 0.2 wavelength, and it only achieves 0.36 wavelength on 40 meters. As with all of the horizontal wire antennas, it could benefit from additional height.

Table 4. Fanned 80-40-Meter Dipole Dimensions and Modeled Performance at 50'

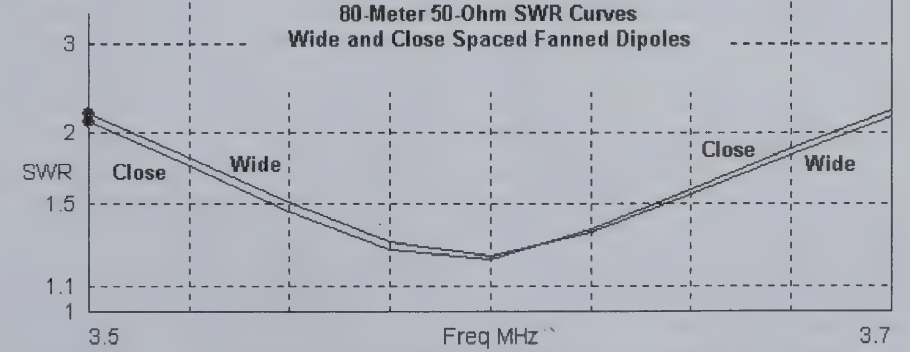
Frequency MHz	Length feet	Gain dBi	TO Angle degrees	Feedpoint Z R+/-jX Ohms
Wide-Spaced Version				
3.6	130.4	6.63	86	61 - j 1
7.1	67.0	4.82	44	54 - j 0
Close-Spaced Version				
3.6	130.4	6.80	88	61 + j 2
7.1	75.3	4.85	40	58 + j 2

We cannot see much difference in performance between the two versions of the antenna on the design frequencies, but we did note the 40-meter dimension change to obtain that performance. The 80-meter length did not change as we altered the spacing of the 40-meter ends from the 80-meter wire. Obviously, in a fanned dipole arrangement, we expect the shorter wire to undergo more change than the longer one. The question is how we can sample the long-wire stability and the short-wire variability.

One way to see the difference is to examine the 50-Ohm SWR curves for the two versions of fanned dipoles. Since the 80-meter wire remained stable, we would expect the SWR (as a measure of changes in resistance and reactance) also to remain stable. Fig. 16 tells the story.

The 40-meter 50-Ohm curves stands in stark contrast, as revealed by Fig. 17. The wide-spaced version of the antenna covers over 2/3 of the band. The close-spaced version barely handles 100 kHz. While the narrower bandwidth may be satisfactory for some operational needs, it also indicates that pruning the close-spaced 40-meter dipole to length is likely to be a somewhat ticklish task. To understand why closing the space between the dipoles shrinks the usable passband of the higher-frequency dipole, we should make at least one more probe into the operation of the antennas. Modeling software gives us a look at the current distribution along the

Fig. 16

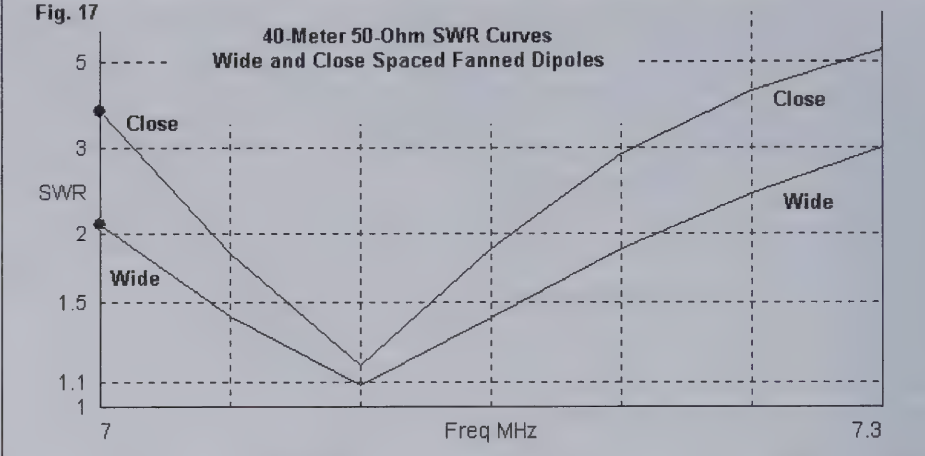


dipoles. Let's compare the currents on both versions of the array.

Fig. 18 shows in the curves on the left the relative currents on the wires during 40-meter operation. Notice that, despite the high impedance of the 80-meter dipole, there remains a low but significant current on the wire. Even with wide spacing and a predominance of current on the 40-meter wire, the two dipoles do not achieve the kind of independence that casual fanned-dipole theory suggests. When we move to the right and examine the closed-spaced version of the array, we see a considerable increase of current on the 80-meter dipole. The closer that we space the two dipoles, the higher the current on the longer one. The higher the current that we find on the longer dipole, the narrower will be the operating passband of the shorter dipole and the more painful will be the job of setting its proper length. As well, we are likely to find that a set of lengths that is right for one antenna height is not right for a different height.

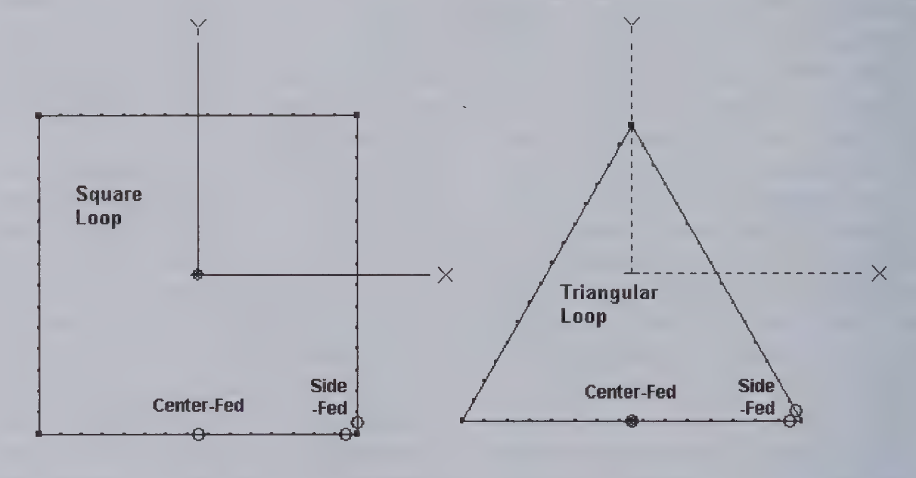
Fanned dipoles have served me well over the years, but only when I restricted the number of bands covered and when I separated the shorter dipole ends as far as feasible from the longer wire. As well, a 2:1 frequency ratio has tended to yield the most successful antennas with the widest operating bandwidth. Still, do not count the fanned dipole out when it comes to flexibility. I once tied a 10-meter vertical dipole to a horizontal 15-meter dipole with good success. One might even use close spacing (and patient pruning) to set up a combination for 12 and 17 meters or for 17 and 30 meters, where operating bandwidth is less of a question. However, I likely would steer away from combinations like 40 and 15 meters or 30 and 12 meters.

Fig. 17



Relative Current Magnitudes on Each Wire
Wide- and Close-Spaced Fanned 80/40-Meter Dipoles

Fig. 18



2-WL 80-Meter Loop Models

Fig. 19

4. The HOHPL—Horizontally Oriented and Polarized Loop

The horizontal loop is subject to several misconceptions. Two of the most popular are that 1. The longer I make the loop, the more gain I get, and 2. The loop gives me omni-directional coverage on all of the HF bands. Basically, if you want more gain, then place the antenna higher. Moreover, even if you create a perfect circle, your pattern will not be circular on almost any band. Nevertheless, the loop is a good multi-band antenna easily fed with parallel transmission line and an ATU.

Fig. 19 shows the outlines of te two most popular shapes for a horizontal loop: the square and the triangle. Almost any other closed shape—regular or irregular—is possible. Most polygons with more sides tend to act like squares, so the contrast between the square and the triangle become good guides on what to expect from a loop strung along the perimeter trees in an average yard. Each loop shows 2 (different) feedpoints: a mid-side location and a corner location. These two points tend to coincide with the most convenient installation points from which to run the parallel feedline from the antenna to the ATU. You can select an alternative position and nothing evil will happen. However, the patterns will not be as regular as the ones that we shall use for demonstration purposes.

I prefer to use a 2-wavelength loop at the lowest frequency of operation. In fact, our demonstration loops will be 560' loops with 80 meters as the lowest band. Loops have a peculiarity. If we make them about 0.75-wavelength or smaller, they tend to radiate off the loop edge. If we make them close to 2 wavelengths or larger, they also tend to radiate off the edge. However, if we make the loop 1-wavelength—or thereabouts—at the frequency of operation, then it radiates broadside to the loop. Hence, a horizontal 1-wavelength loop becomes a good NVIS antenna, as our 80-

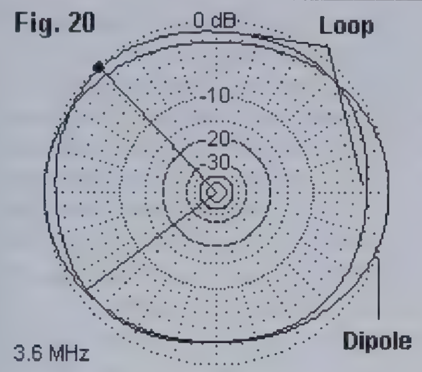


Fig. 20

Comparison of 80-Meter Dipole and 2-WL Loop Azimuth Patterns with Antennas at 70' above Average Ground

meter 2-wavelength loop would become on 160 meters. Incidentally, we shall place the demonstration loop 70' above ground simply for the exercise. 70' is about 1/4-wavelength on 80 meters but 2 wavelengths on 10 meters.

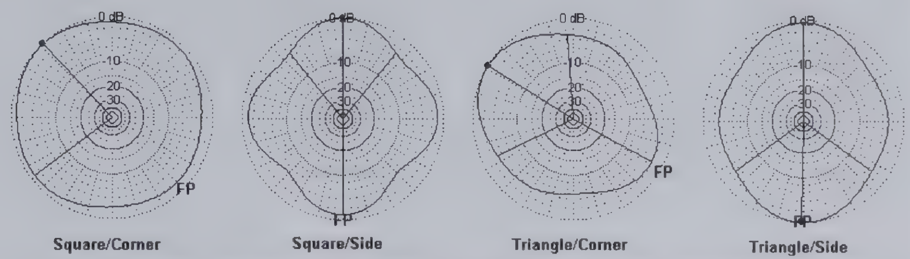
The phenomena of changing planes of radiation as we enlarge a loop will explain why my list of the top five multi-band antennas does not include any vertically oriented loops. Lets start with a 1-wavelength loop. It does fine on the band for which it is cut. However, by the time we double the frequency of operation, the loop is radiating off the edge, producing mostly high-angle radiation. Such loops will make contacts, but not as well as a horizontal loop.

On the lowest band of operations, we do not choose the loop for gain. As shown in Fig. 20, there is very little gain difference between the loop and a resonant dipole at the same height. The mid-side-fed square loop used to generate the loop part of the pattern is not even significantly more omni-directional than the dipole pattern. However, at their lowest operating frequencies, loops tend to show a lower radiation angle than a low dipole. In the case that uses antennas at the 70' level, the dipole's take-off angle is 58 degrees, but the loop's angle is between 44 and 50 degrees, depending upon the loop shape and the feedpoint position. This advantage is useful at the lowest operating frequency, but it does not last as we increase frequency. By the time we double the operating frequency, the take-off angle for loops tracks well with the take-off angles for doublets at the same height.

Table 5. Modeled Performance of 560' Horizontal Loops at 70' on Selected Amateur Bands

Note: Performance shown as Maximum Gain (dBi)/TO Angle (degrees).

Loop Frequency	Square Corner-Fed	Square Side-Fed	Triangle Corner-Fed	Triangle Side-Fed
3.6	5.9/50	6.7/44	7.1/48	6.4/45
7.0	10.6/27	9.9/26	9.7/28	10.4/28
14.0	12.9/12	11.6/12	13.9/13	11.2/13
21.0	14.6/ 9	14.3/ 9	13.4/ 9	12.4/ 9
28.0	15.1/ 7	13.6/ 7	14.1/ 7	11.0/ 7



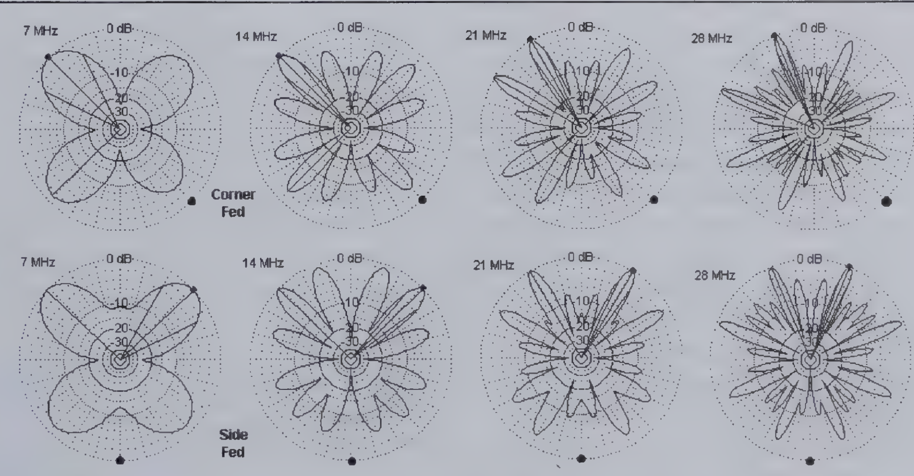
Azimuth Patterns of an 80-Meter 2-WL Horizontal Loop at 3.6 MHz for Square and Triangular Shapes and for Corner and Mid-Side Feedpoints

Fig. 21

Loop antenna shape and the position of the feedpoint do make a difference to the antenna's pattern and performance. Fig. 21 shows the 3.6-MHz azimuth patterns for the two loops (square and triangular) with both corner and mid-side feedpoints. The notation FP on the plots shows the relative position of the feedpoint to the development of the plot. The triangular plots are—relative to the feedpoint position—more alike than the two plots for the square loop. In both triangle cases, the direction of the main lobe crosses the feedpoint and a point in the middle of the opposite side. The main difference is a reverse in the slight gain advantage. For the corner-fed triangle, maximum gain is away from the feedpoint, while in the mid-side version, gain is more toward the feedpoint. The squares, however, show a more distinct pattern difference, depending upon the feedpoint position. The corner feedpoint produces a nearly circular pattern, while the mid-side feedpoint yields a 4-lobe pattern.

Although there are no major differences in gain, Table 5 presents the modeled maximum gain values and take-off angles for the 4 loops on various HF bands, using our basic 560' loops at 70' above average ground. Because we shall use an ATU, the feedpoint impedance data is not especially useful here.

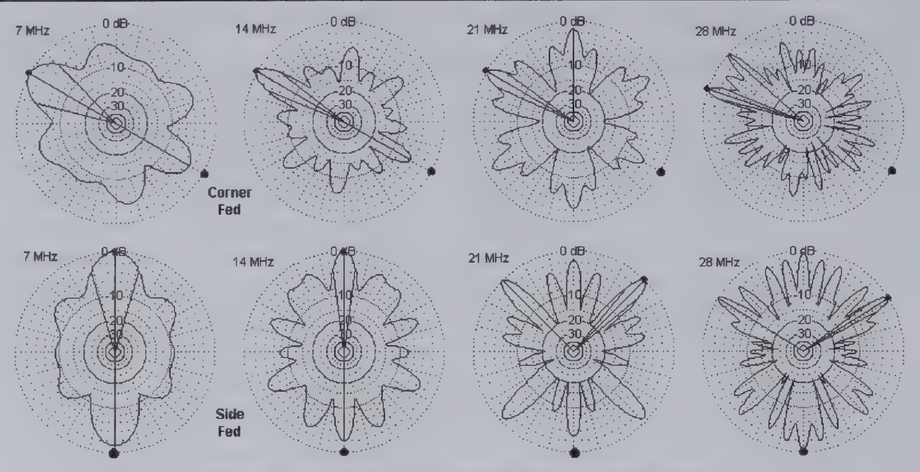
I have inserted Fig. 22 immediately following the chart of modeled gain values so that you will not make too hasty a decision on which loop to select. It shows the patterns on 40 through 10 meters that produce the gain figures in the chart, at least for the square loops. Above 40 meters, we discover patterns with many lobes. The higher we



● = Feedpoint

Square 2-WL 80-Meter Loop Azimuth Patterns on Higher HF Bands

Fig. 22



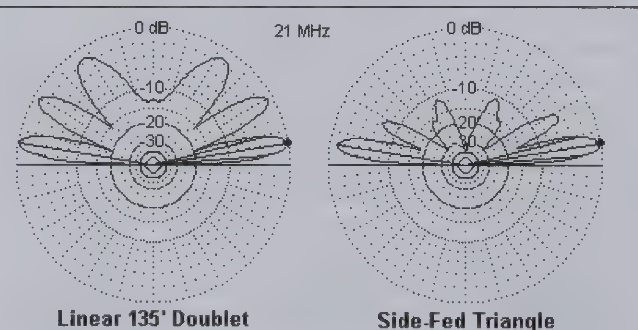
Triangular 2-WL 80-Meter Loop Azimuth Patterns on Higher HF Bands

Fig. 23

go in frequency, the more lobes we encounter and the more variable we find the lobe strength. As a general rule of thumb with simple wire antennas, the higher the gain of a lobe, the narrower its beam width. So we obtain maximum gain only over a small target communications arc. In these patterns, dots serve to locate the feedpoint position on the loop relative to the pattern.

Fig. 23 provides the corresponding patterns for the triangular loop. On 80 through 20 meters, the loop produces patterns that have a distinct axis on the line formed by the feedpoint and the opposing loop position. Above 20 meters, the patterns become as individual as snowflakes, each very regular but distinct from the other patterns. When we combine the patterns of the three plot figures together, we may finally come to understand that on the upper HF bands, horizontal loops do not produce patterns that are more omni-directional than doublets. The patterns are simply different in the relative positions of the lobes and nulls. As well, the chart shows that on the upper HF bands, the radiation angles are similar to those of simple wire doublets.

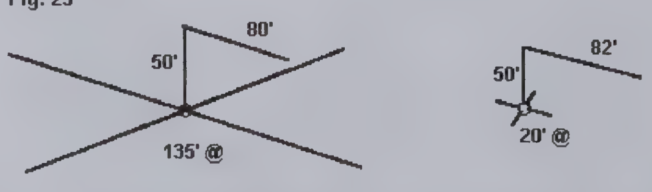
So why choose a horizontal loop as one's multi-band wire antenna? One good reason is the improvement in radiation angle on the lowest frequencies of operation. A second good reason is because you have the perimeter supports already growing in your yard. A third reason is because closed loops tend to be less prone to the build up of static charge relative to doublets with unterminated ends. (This feature does not guarantee immunity from all noise sources. Nor does it guarantee immunity from the hazards or lightning and associated thunderstorm dangers.)



15-Meter Elevation Patterns for a 135' Doublet and a 560' Side-Fed Triangle

Fig. 24

Fig. 25



2 Versions of the 160-Meter Inverted-L with 4 Buried Radials

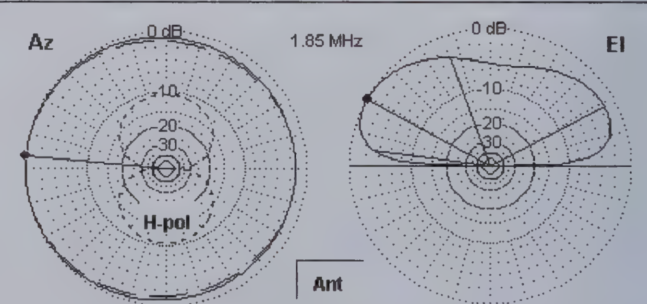
A fourth reason is because large closed loops tend to have less high-angle radiation. What may be more important, this fact means less receiving sensitivity to high-angle sensitivity to QRM and QRN from closer-in sources. Fig. 24 compares the 21-MHz elevation patterns for a simple 135' linear doublet and a 560' triangular loop with its feedpoint in the middle of one side. Although the exact shapes of the 15-meter elevation patterns will vary from one loop to another in the set that we have been examining, they all share the general property of having less high-angle radiation.

The loop has several advantages that recommend it as a multi-band antenna, if you can live with the upper band patterns, if you have room for the array, if you can find the wire and the supports, and if you are prepared for the maintenance that a long stretch of wire requires. All those "ifs," of course, represent the disadvantages of the horizontal loop.

5. The Inverted-L

In principle, the inverted-L is any antenna that physically looks like a tipped-over letter L. Electrically, it includes not only tuned systems with radials, but as well, any sloping wire that runs from an antenna tuner at ground level to some higher end-point. (A sloping wire has essentially the same vertical and horizontal radiation components as the more formally positioned L.) What we used to call a random length, end-fed wire belongs in this group as much as the 160-meter inverted-L with 64 radials at its base.

In more practical terms, the average backyard antenna builder is unlikely to lay down a major radial field for the most efficient 160-meter operation. The portion of



Azimuth and Elevation Plots of an Inverted-L on the Lowest Frequency of Operation

Fig. 26

the antenna above ground is no problem, since it involves running a wire up as high as available supports will permit and then running the remainder horizontally. The radials are the major hindrance to using the inverted-L. So let's reduce the radial field to a mere 4 radials, each 1/4-wavelength long at 160 meters, that is, about 135'. With this reduced field, let's assume that we have 50' of vertical support. Then an all-band inverted-L will look something like the left-hand portion of Fig. 25.

To achieve resonance on about 1.85 MHz with AWG #12 wire throughout, we need an 80' horizontal run. Incidentally, in my model, the radials are buried 6" deep in the ground, but the exact burial depth is not critical. Now let's add a second dose of reality. Many hams have backyard filled with gardens, children's toys, garages, etc. Hence, we find an unwillingness to commit to more than short radials. So the right-hand side of Fig. 25 shows the same set-up with 4 20' radials. The horizontal section of the antenna needed a 2' extension to restore resonance at 1.85 MHz. Now let's compare performance (Table 6).

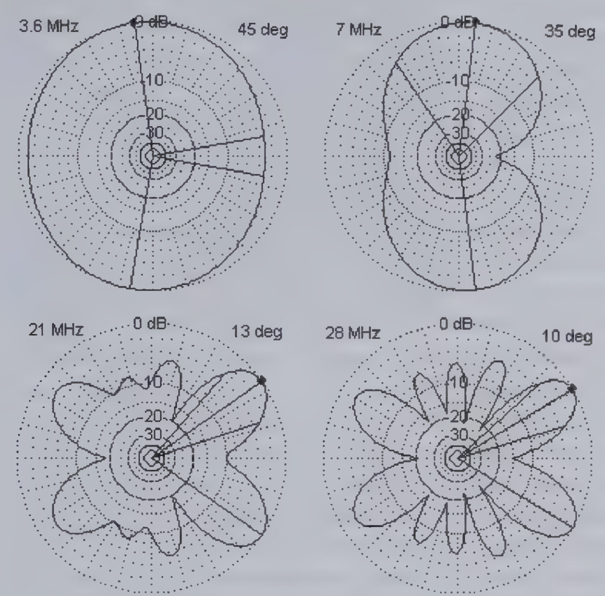
In practical terms, we find a significant performance difference only on 160 meters. The #12 inverted-L is under ideal conditions about 2 dB less effective than a full size vertical monopole. When we shorten the radials, we lose another half-dB of gain. Otherwise, the two systems are roughly equivalent for all-band operation. The short radials and longer horizontal section of the smaller system do raise the impedance values, but if a tuner will handle one set, it will also handle the other.

Fig. 26 shows the patterns for 160 meters, with the antenna orientation marked. Note that the horizontal section offsets the vertical monopole pattern away from itself by a small amount. Also note that there is still significant current in the horizontal portion of the antenna. This shows up as the figure-8 horizontally polarized component of the pattern that is about 10-dB down from the vertically polarized component.

As we move above 160 meters, we can discover one reason why many inverted-L users think of the antenna as a good (even if not perfect) general communications antenna. Fig. 27 provides patterns for selected ham bands, with the frequency and the TO angle noted for each azimuth plot. Relative to patterns for closed loops

Table 6. Inverted-L Performance with Full and Short Radial Systems

Antenna	135' Radials			20' Radials		
Frequency MHz	Gain dBi	TO Angle degrees	Feed Z R+/-jX Ohms	Gain dBi	TO Angle degrees	Feed Z R+/-jX Ohms
1.85	-2.2	29	38 - j 2	-2.6	29	47 + j 2
3.6	3.5	84	4500 + j1750	3.8	84	5200 - j150
7.0	4.0	35	700 + j 750	4.0	35	900 + j 800
14.0	5.2	22	300 + j 300	5.3	23	350 + j 350
21.0	6.0	13	200 + j 80	5.8	13	250 + j 200
28.0	7.7	10	200 - j 100	7.5	10	200 + j 30



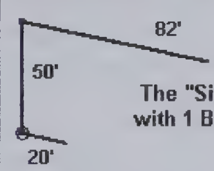
Azimuth Pattern Shapes for Selected HF Bands for the Inverted-L Antenna

Fig. 27

and linear doublets, the patterns are almost all more equally distributed around the horizon. As we increase frequency, the combination of increasingly strong horizontally polarized radiation and the remnant vertically polarized radiation tend to provide a modicum of gain in almost every direction. Only when we reach 10 meters do we find a pattern of well-defined lobes and nulls, but the nulls are not as deep as those we find with loops and linear doublets. The cost of the fuller coverage is lower maximum gain.

There is no significant difference between the pattern shapes for the L with a full radial field or the L with short radials. Remember that these patterns apply to an inverted-L with a 50' vertical section. If you bend the L at a lower height, the TO angles for 80 through 10 meters will rise, and the gain and exact pattern shape may change. However, let's consider one more version in which the user does not lay down a symmetrical (or thereabouts) radial field. The one thing necessary to the use of the inverted-L is a good RF ground, so this user lays down 1 buried radial about 20' long. See Fig. 28.

As Table 7 shows, performance does



The "Simplest" Inverted-L with 1 Buried Short Radial

Fig. 28

diminish relative to the other systems. However, only on 160 meters, where we lose another 3dB of gain, is the result unworkable. On the other bands, we obtain usable performance. For emergency and field operations, the 1-radial inverted-L may be usable from 80 through 10 meters. However, for home use, we should strive to add as many radials—shaped however the ground will perm it—as we can, even if we only add one every few months. The usual safety precautions apply to radials: get them below ground where playing children, gardening spouses, and seeing-eye lawn mowers cannot reach them. If you use a tree to support the feed-end of the antenna, be sure to space the vertical well away from the tree trunk. In addition, make sure that no one can touch the antenna or its feedpoint during operation.

You will note that the 80-meter

impedance is very high, higher than most antenna tuners can handle. For this reason, many inverted-L users prefer to use wire lengths longer or shorter than the 130' length that I used in this demonstration. A 3/8-wavelength inverted-L (about 100' including both the vertical and horizontal sections) will move the very high impedance frequency to the 30-meter band. Pattern shapes will change, but the general properties of the inverted-L will remain: good (but not great) bulbous patterns for general communications in almost every direction.

One final question: where do I place the antenna tuner? The answer is simple: at the antenna feedpoint. This position is standard in the field, where we usually terminate the antenna at the operating position with a manual antenna tuner. For this antenna, we actually need a single-ended network tuner. At home, the inverted-L is an ideal application for one of the weather-protected automatic tuners (using precautionary additional weather shielding) with the case or ground lead connected to the radial side of the system. The advantages of this type of system are obvious: automatic (or semi-automatic) tune-up with a coaxial cable from the antenna feedpoint to the rig. The disadvantages are the initial expense of the automatic tuner and periodic preventive maintenance.

Table 7. Inverted-L Performance with One Buried 20' Radial

Frequency MHz	Gain dBi	TO Angle degrees	Feed Z R+/-jX Ohms
1.85	-5.7	29	82 + j 17
3.6	3.7	88	5300 - j100
7.0	3.5	35	990 + j 800
14.0	4.4	22	450 + j 350
21.0	4.6	13	300 + j 150
28.0	6.0	10	250 + j 10

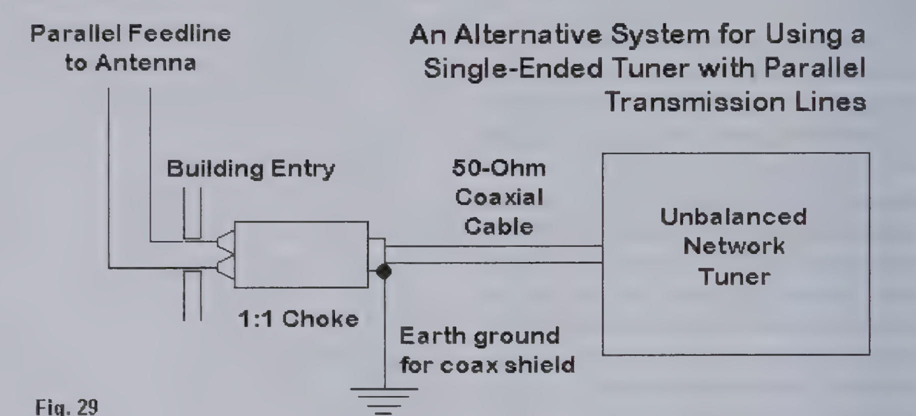


Fig. 29

Final Notes

We have now surveyed my personal five favorite multi-band wire backyard antennas. There are others that I might have included. In fact, I thought of some others, but gradually discovered that they were mostly variations of the ones that I included. For example, there are some sloping and bent wire antennas calling for either measured or random-length "counterpoises." However, they are simple variations on the inverted-L. Linear dipole-doublets have inverted-Vee variations.

I have omitted antennas using traps, simply because traps require maintenance and represent an advanced project for most folks who roll their own. All of the antennas I chose involve only wire and feedline plus, of course, the antenna tuner. For all but the inverted-L (and possible the fanned dipoles), we need a balanced tuner that will handle a very wide range of resistance and reactance at its terminals with the highest possible efficiency. Although there are a few balanced network and Z-match tuners available, most hams still use single-ended network tuners with a 4:1 balun at the terminals. Unfortunately, not all 4:1 tuner baluns are made equal, and many show high losses in the presence of either high reactance values or very low impedances that may occur as the feedpoint impedance is transformed along the parallel feedline.

There is an alternative system for using the single-ended network tuner in the manner in which it is most efficient: as a single-ended network. Fig. 29 shows the essentials. At the shack entry point, we terminate the parallel feedline with a 1:1 balun. Actually, the unit is a simple choke in preference to a transmission-line transformer that prefers a minimum of reactance. A W2DU-type choke composed of about 50 ferrite beads around a length of coax tends to work quite well in this application. We run a lead to an earth ground from the coax braid right at the coax side of the choke itself. This measure tends to attenuate any remnant RF that might get onto equipment cases or into circuitry. Make the coax run as short as possible using the lowest-loss coax that you can obtain, since there will still be a considerable SWR on the line to the tuner. However, this line goes directly to the coax connector on the tuner output side for single-ended processing. The system is not perfect and does have small losses. However, in most cases, it tends to clear the shack of unwanted stray RF from indoor parallel feedlines, and it does allow the single-ended tuner to effect a reasonably efficient match with the remainder of the antenna system. This system is not new, being almost as old as the W2DU-type choke itself. I first recommended it as one solution to problems some folks had back in 1980 with G5RV antenna systems.

There is a vast territory that these notes have not covered. We can make multi-band beams, multi-band verticals, and a number of other antennas that will cover 2 or more of the ham bands. I encourage you to experiment with antennas, since wire is inexpensive and you can develop temporary mounts to put up and take down your trial antennas. But when you do erect an antenna, please be sure to give it that same care that you give your transceivers. Periodic preventive inspection and maintenance will ensure that the antenna gives you all the performance that it can every time you fire up the rig. Attention to safety will protect both property and the lives of those you love the most—including yourself.

As for those other possible antennas, there are always future FDIM celebrations to cover them. ●●

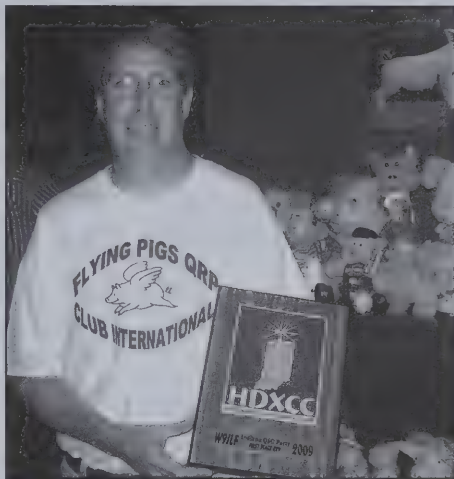
Having Fun with State QSO Parties

Ivin Flint—W9ILF

The ARRL declared 2009 the year of the QSO party. A QSO party is an event that a state or group of states puts on to encourage QSOs within the state and get outside state stations to also participate by finding stations within the party. These events are set up much like a contest/sprint, but each one will have its own style. Some pride themselves in being friendly like the MD/DC QSO party. Some are faster pace and more contest-like such as my state's Indiana QSO party. One particularly interesting thing I found is that many have a QRP division to enter into.

My QRP operating has included rag chewing, trying to get "worked all states" within a year, and chasing DX, but I didn't have much to do while looking for a new state or country. Looking through my QSL cards, I decided to see what counties I had and discovered the fun of county hunting. I think this is one of those things many of us just don't think about after a new QSO. I do my general logging the old fashioned way in a paper log. To keep track of my confirmed counties, I cut the top off my MFJ-971 tuner box and folded sheets of paper in half to separate my cards by states. Next, I looked up the counties in each state and wrote them on the inside of the sheets of paper. When I make a new QSO, I open that states sheet and see if I need their county. When I get the confirmed QSL card, I write that station's name next to their county and file it away in order behind the state's sheet. I find one of the best ways to get a new state and county is to participate in QRP sprints and QSO parties.

Last year was my first year to work the Indiana QSO Party. The Indiana QSO party gives special bonus points for working certain special event stations including one called the Bison Stampede and four other special stations. By contacting them you can earn a certificate and increase your score significantly. CW QSOs are worth more than SSB and each new county in the log is a multiplier along with each new outside state/province. Stations participate as mobile, portable, and fixed and are divided by high, low, and QRP power. Certificates and plaques are provided, and this adds to the fun in participating.



My station has been an Icom 703 which works 160 though 10 meters both CW and SSB. I ran 5 watts because this QSO party considers QRP as 5 watts or less. Some states allow up to 10 watts on SSB. My antennas are a ground mounted Hustler 5BTV and an 80M dipole. I came out in first place in Morgan County and as single-Op QRP in 2008. I not only got 22 counties but also 27 states. This year I had the same station set up. I focused on more SSB stations to get a higher county multiplier. I got 5 new counties I needed, but I didn't get as many CW QSOs which in the end lessened my score from last year. I again came in first place in Morgan county and Single-Op QRP and received a nice plaque for the QRP side. For next year, I plan to try something different with antennas, and I have changed my QRP rig to an Elecraft K2. I hope both will work in my favor and help me pass my 2008 high score. This year, besides Indiana, I have participated in the WV, MD/DC, GA, and OH QSO parties as well and plan to get in more before the end of the year. Each has a unique flavor all its own which keeps things fresh and interesting, so before jumping into a QSO party, I advise to take at least a quick look at the rules.

There are many benefits to QSO party participation with QRP. That extra challenge of running 5 watts forces you to think seriously about that antenna set up. I was amazed when I took the time on SSB to mention I was QRP the comments I received. Most are favorable surprises at how well my signal was getting out. Some will hardly believe it. By trying to get into a specific state you see how well your antenna set up is working to a specific area of the United States. This can help you down the road in other events such as field day and larger North American contests. It can also help you know how well you can expect your station to work locally if needed in case of an emergency. Call CQ for your own state and represent your county. It will help your operating skills and give you that experience of what it feels like to be the hunted instead of the hunter. You might appreciate that next DX station's efforts more the next time you call. You also might just start enjoying those trips to the mail box to discover a return QSL card from the last QSO party that adds to the list of counties you can confirm you have worked. It all adds up to a lot of fun. Discover the enjoyment and rewarding experience of QRP in the next QSO party.

Ivin Flint W9ILF

2010 State QSO Party Dates *(source: WA7BNM Contest Calendar)*

Feb.	6-7	Vermont	May	1-2	Indiana
	6	Minnesota		1-2	New England
	6-8	Delaware	Aug	21-23	New Jersey
Mar	14-15	Wisconsin		28-29	Ohio
Apr	3-4	Missouri	Sep	18-19	Washington
	10-11	Georgia		25-26	Texas
	17-18	Michigan	Oct	2-3	California
	17-18	Ontario		9-10	Pennsylvania
	24-25	Nebraska		17-18	Illinois

Several other states' have QSO Parties, but their 2010 dates were not included in this major contest calendar web site listing at the time of publication.

Making a Replica of the Paraset

Bob Kellogg—AE4IC ae4ic@att.net

I'd been looking for just the right project to build using tube technology when I found out about the Paraset (see the companion article on Paraset history). I was just a kid during WWII, and played "War" with the other kids on our block. Especially after seeing a movie showing secret agents operating behind the lines, we would all be secret agents for a week. The MK7 Paraset would have been our ideal radio. Since it's small, QRP power and size, and operates on two of the current ham bands, it seemed ideal for my glow-bug building project.

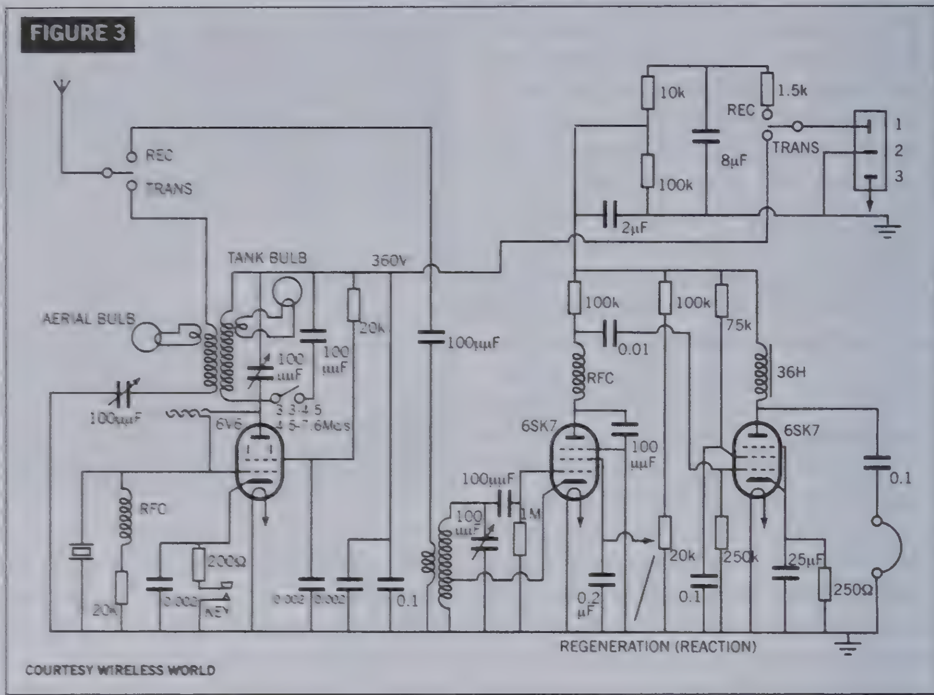


Figure 1—Paraset schematic.

I decided to build the metal case version. It was about the size of a large Kleenex box and contained the complete transceiver, including a built-in key. It was easy to store and hide and move quickly if necessary. Only a few feet of antenna wire were required. The Paraset operated from a separate six volt vibrator supply, so a car battery could power it. It used a 6V6 as a crystal controlled oscillator/transmitter with an output of 4 to 7 watts. The regenerative receiver consisted of two 6SK7s. The receiver was very sensitive, but not very selective. A two-position range switch allowed continuous operation between 3.3 and 7.6 megacycles. Earphones supplied the audio. Figure 1 shows the schematic I used. As I later found out, there are at least two versions of the schematic with minor variations between the versions.

The Paraset is described in some detail in the book *Secret Warfare* adapted by David Kahn, who translated it from the original French book written by Pierre Lorrain. This book, ISBN 0-85613-586-0, covers much of the equipment used in the clandestine warfare of WWII, including a section on the various secret code systems used.

Finding the Parts

The first task associated with a vintage construction project is always finding the parts. In my case, I found most of the necessary parts at Dayton last year. They are all available with some searching. Most of the internal small parts can be obtained by robbing them from an old tube-type radio. I deviated from the "authentic" a little bit on the internals. I used some silver micas and other caps that were not vintage. The original Paraset used wafer tube sockets, but I used Bakelite sockets.

The hardest part to find is the 36 henry choke. I'm told that anything above about 18 henrys will work. I used a large (too large) 30 henry choke that was all I could find. I didn't have a good way to measure such a large inductance, but I think the primary of an old tube type output transformer would work since the current drain is very low.

Some other parts that were hard to figure out were:

a. The power plug. This turned out to be standard three pin Cinch-Jones connectors. The original used a female plug on the chassis and a male plug on the cord. For safety reasons, most of the replicas reverse these plugs but I did not.

b. The crystal jack was 3/4" spacing for large pins. I found three jacks at Dayton and bought them all, along with some crystals. When I got home, I discovered that two of the jacks were for slightly smaller pins than the vintage crystals.

c. The coils in the set are homebrew. You can find details of making the coils and parts for the hand key at IKØMOZ's excellent Paraset website, http://www.qsl.net/ik0moz/paraset_eng.htm.

Be aware also that there are three 100 mmfd variables and one of them must have an insulated frame. The aerial and earth jacks are simply banana jacks.

Construction

The pictures below show my Paraset in various stages of construction. Several other hams have started construction of their own Parasets so before long we hope to have an all-Paraset roundtable QSO.

Figure 2—The case after construction.

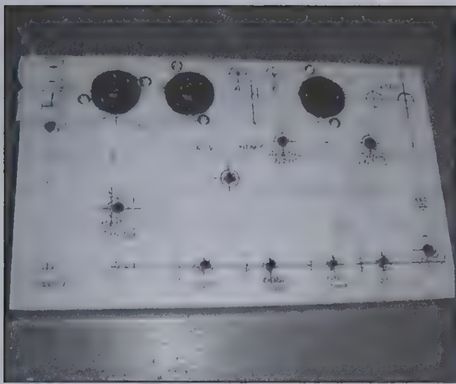


Figure 3—The chassis with tube sockets installed.

Figure 4—Major components installed and ready for wiring.

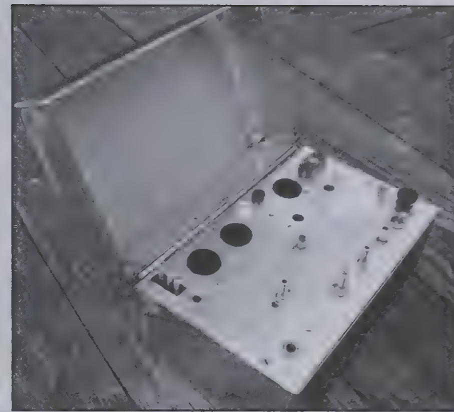


Figure 5—Ready for painting and wiring.

Building the case is an interesting problem. It has to be fashioned pretty much by hand if you want to build a real replica. The originals were made of steel, and mine is made from the tops of a couple of old VCR cases. The top and bottom pieces were bent first, into a "U" shape. Then, the end pieces were bent with tabs fitting inside of the "U"s. I used an aluminum chassis which just fit inside the bottom.

Figure 2 shows the case as it was constructed from sheet steel. Regular galvanized steel, about 20 gauge, was used for the end pieces and for the 1/2" strip around the top edge. This strip becomes the lip that overlaps the bottom of the case. I cleaned (sanded) the joint between the ends and the top and used an old, heavy, 250 watt soldering iron to make the joints. Soldering is tedious, and should be done starting at the center of a seam, working toward the end or edge. If you start at one end and work toward the other, the two pieces of metal will expand at different rates, resulting in gaps or corners which

cont. on p. 44.

A Short History of the Paraset

The remarkable little rig that came to be known as the "Paraset" came into being c. 1941, as a means of providing Allied clandestine field operatives with an ability to transfer intelligence information back to Britain. The set was apparently designed at the main receiving site at Whaddon, and officially known as the Whaddon Mark VII. At least one knowledgeable source involved in the production of these sets claims that "Paraset" was never an official name, but instead was a kind of nickname that came about from the practice of issuing the sets to agents that would be parachuted into enemy-controlled territory.

Original technical information on the Paraset is somewhat scarce, as Winston Churchill ordered most documentary evidence of support for clandestine operations of that period destroyed immediately after WWII. His aim was to prevent it from falling into Soviet government hands. Nevertheless some information survived, most notably from a Belgian ham named Joe le Suisse, ON5LJ (SK). ON5LJ's information has been preserved by Jo Scholtes, ON9CFJ, who later passed it on to Mario Galasso, IKØMOZ. Mario, by the way, has an excellent website (http://www.qsl.net/ik0moz/paraset_eng.htm) for those interested in replicating the Paraset.

Historical information on the development of the Paraset comes primarily from the few personnel who were a part of its development and are still available for comment. Geoffrey Pidgeon, author of *The Secret Wireless War* [1] has supplied much of the information [2] through his own knowledge gained when he was a part of the development team, and through his contacts with others in the team. Mr. Pidgeon himself was involved in early production and his father was in charge of Stores (Supplies) at Whaddon.

Mr. Pidgeon writes that the R&D team developing the Paraset was led by Dennis Smith, "a brilliant wireless engineer." Mr. Smith later went on to a Mobile Construction section that designed and built the Ascension air-to-ground agent contact system and a number of other transmitters and receivers intended for agents and Resistance fighters. There were a total of approximately nine people involved in the development, which apparently started sometime in 1941. By 1942, Mr. Pidgeon had been assigned to the metal workshop at Whaddon Hall, and states that they were making small runs of about twenty Mark VII sets by the end of that year.

As can be seen from Figure 1, the Paraset consisted of a simple two-valve (tube) receiver and a single-valve transmitter. [3] The power supply was contained in a separate enclosure and used batteries as the primary energy source, feeding a vibrator-based power supply to supply the necessary high voltages. The receiver consists of a regenerative detector and a single stage of audio amplification. This design scheme was quite common at the time among amateur radio operators of modest means because it required the fewest number of expensive valves. The transmitter was a high powered (5-7 watts), crystal controlled oscil-

cont. on p. 45.

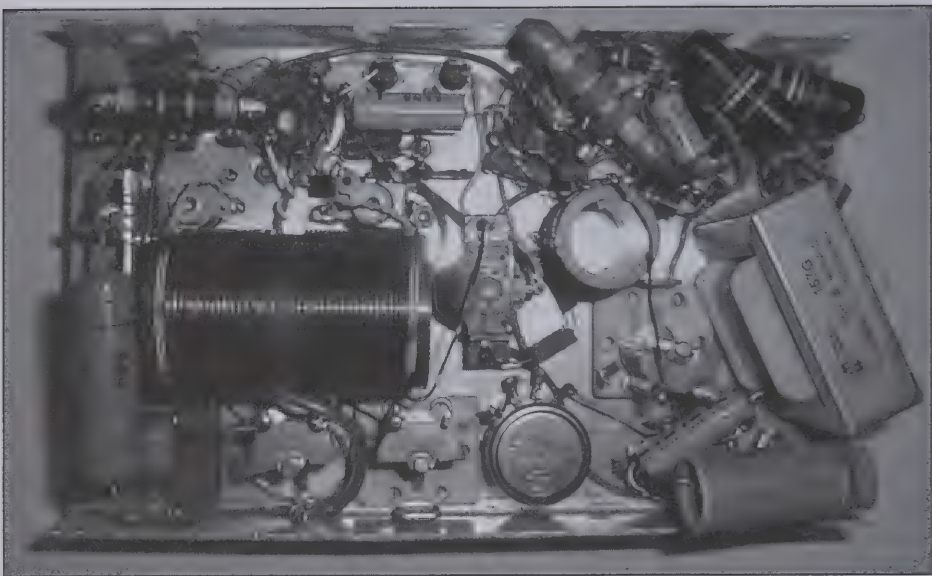


Figure 6—Closeup of the completed chassis.

Figure 8—Built-in hand key.

Figure 9—The completed paraset.

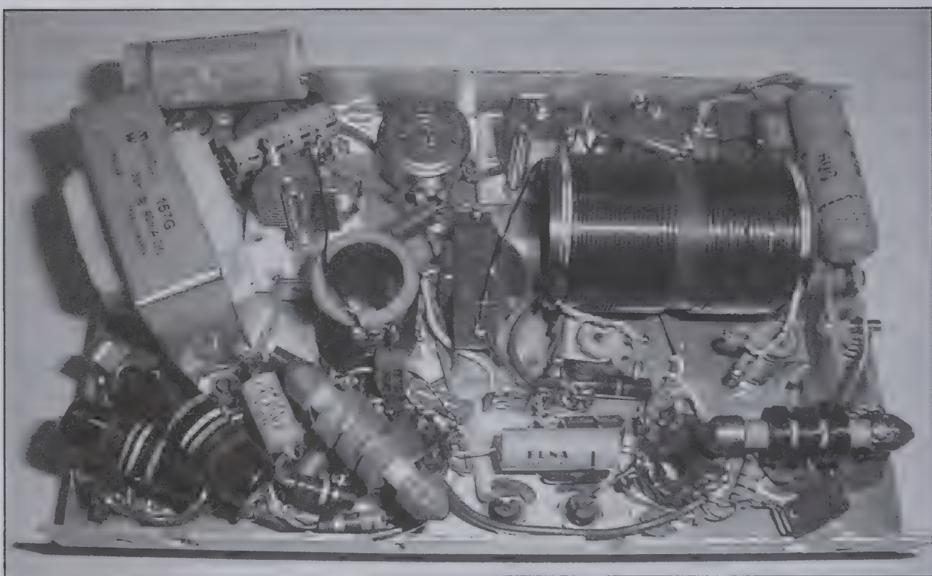


Figure 7—The chassis from another viewpoint.

don't seem to match. However the soldering is done, this problem of differential expansion should be considered and made to work for you instead of against you. After the top and bottom shells were complete, I cut a 1/2" strip of metal and soldered it around the open edge of the top, forming the lip which overlaps the bottom of the case. Small gaps in the solder and other deficiencies can be repaired with automobile body putty before the final painting. Mine is painted with Krylon No. 1606 Pewter Gray Gloss, which is very close to some of the original WWII colors.

Figure 3 is the aluminum chassis, covered with masking tape and marked for the various holes. The tube sockets have been mounted.

Figure 4 shows the underside of the chassis ready for wiring, with all of the hardware mounted. Note the choke which is twice the size of the original. The rotary wafer switch in the middle was later replaced by a smaller rotary DPDT.

The unfinished case and chassis fitted together before wiring and painting is shown in Figure 5.

In Figure 6, wiring has been completed. There are two or three layers of parts in some places. Note that a mixture of vintage and modern capacitors and resistors were used in the interest of conserving space.

Figure 7 shows the wired chassis from another viewpoint. Note the yellow two-turn coils at each end of the main coil. These are pickup loops for the tuning indicators. During final testing these loops were reduced to one turn each to keep from burning out the indicator bulbs.

Figure 8 shows an end view of the chassis, highlighting the built-in hand key which was a feature of the Paraset. The key mechanism must be hand made. It's a simple lever with spring tension at one end and a screw adjustment on top of the chassis. The contacts are between the plastic block and the lever. The knob protrudes from the lever through the top of the chassis. The smaller screw holds the key in place.

Figure 9 is the completed Paraset as it appears when the case is opened. Note the tubes are stored in clips inside the lid. The chart converts the 0 to 100 dial readings to megacycles, as the units of frequency were called in those days.

lator connected directly to a single wire antenna, which was never more than 20M long and often much less. Again, this was a common design scheme of the time. Because of the transmitted power level, the Paraset might be considered the first QRP rig used for official purposes.

The small number of tubes and low power output from the transmitter also contributed to low power consumption, an important factor in clandestine sets. Batteries were often used in these sets as the primary power source for reasons of dependability. Mains power was not always available, and could disappear at any time. In many instances, agents had to operate in very rural settings where electrical power was non-existent. Even though the Paraset was relatively frugal in its use of power, it was still necessary to carry along at least one and possibly two automobile batteries. Moreover, the batteries had to be charged relatively frequently and that posed considerable operational risks. However, the use of batteries also provided a defense against a common detection technique used by German direction finding teams. The teams would routinely cut off power to a section of the city while listening to what they thought might be a clandestine transmitter. If transmissions stopped coincident with the power being turned off, they could narrow their search to a specific part of the city.

The low power output was nevertheless adequate for the purpose, given the large antennas and sensitive receivers at the listening sites in England. A recent propagation study [4] has shown that an antenna efficiency of just a few percent would probably have resulted in an SNR of 20 dB or so for a path from Calais in France to the Whaddon receiving site. A path from Marseille to Whaddon would have resulted in a similar SNR. However, the designers probably did not do studies of this type in considering requirements for the Paraset. More likely, they would have relied on personal knowledge of communications with low power transmitters over the distances involved. A second factor in favor of the agents was that 1945 corresponded with a solar sunspot maximum, giving the war years very good propagation conditions.

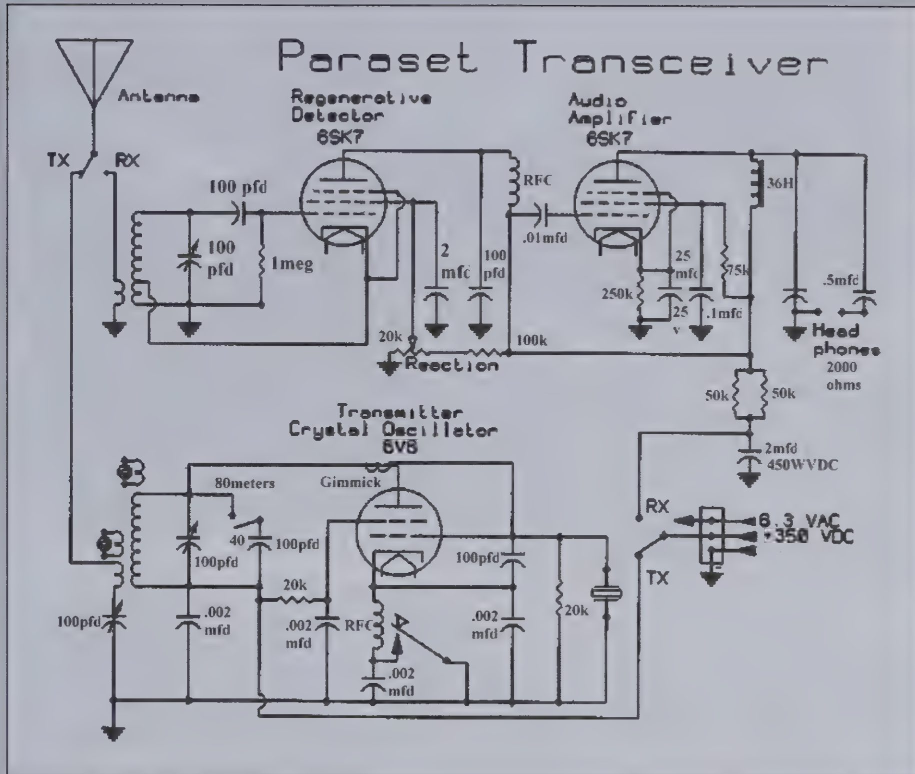


Figure 1—An early paraset schematic.

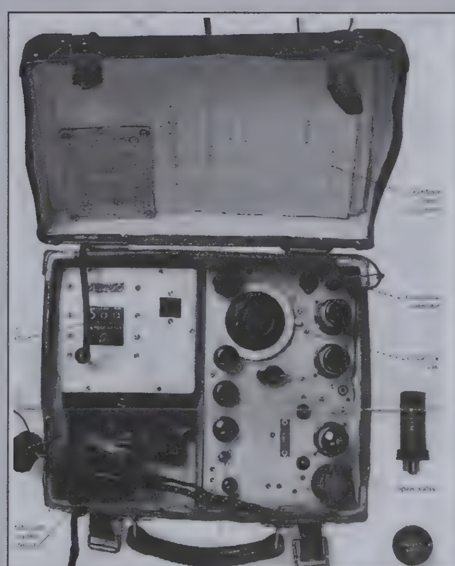


Figure 2—Oluf Reed Olsen's paraset.

The Paraset was apparently an immediate success and production seems to have been transferred to a factory at Little Horwood when it opened in early 1943. Mr. Pidgeon was also transferred to the metal workshop at Little Horwood and remained there through most of the remainder of the war. While there, he made portions of the custom keys and other items which were an integral part of the Parasets. The Parasets immediately began production in lots of fifty and a hundred. Unlike the metal box sets which are most popular with replicators, these early sets were issued in slightly larger wooden cabinets. These sets were normally placed in a small attaché case which would accommodate the power supply and had storage for valves and crystals. Some Parasets were apparently also made in workshops at Watford run by the Special Operations Executive (a group somewhat akin to the US OSS).

Figure 2 [5] is an example of the attaché case variety of the Paraset. The power supply, shown on the left side of the case, is a mains supply and not the vibrator-based supply which was more common. Note the key knob which appears just below the power switch. The remainder of the key is located below the front panel. This was a feature of all Parasets. This particular set belonged to Oluf Reed Olsen, a Norwegian pilot and member of the British Secret Intelligence Service (SIS). Olsen survived the war, and has written a book concerning his

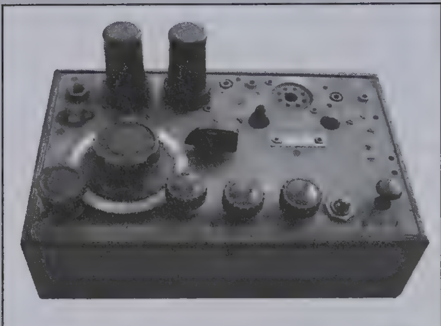


Figure 3—Paraset belonging to Dr. E. Evrard.

adventures. Olsen was either more skilled or luckier (or both) than many of his colleagues undertaking the dangerous mission of relaying information back to the Allies during the war. Many of his colleagues fell prey to German direction finding units, who became quite skilled in finding agents while they were actively sending back information. An interesting point here is that a regenerative receiver of the type used in the Paraset is often capable of transmitting an inadvertent signal of its own, thereby aiding the direction finding units. However, measurements made on SM7EQL's replica set showed the receiver radiation at full regeneration to be –38 dBm, which equals 158 nW. This is probably another indication of its excellent design, and a feature that was probably greatly appreciated by its users.

A second example of the wooden variety Paraset is shown in Figure 3. [6] This particular set is owned by Dr. E. Evrard, who discovered it in his late father's effects whilst clearing his late parents' home. According to Dr. Evrard, he recollects playing with the set as a small child and says that it was given to his father by M. Georges Ronval, a member of the

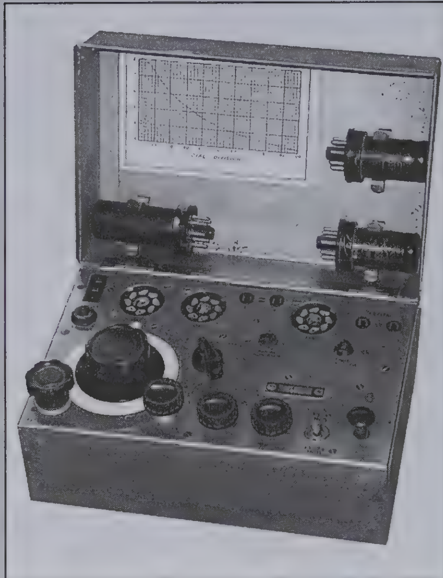


Figure 4—A "cash box" paraset.

Belgian resistance during WWII. M. Ronval worked for Belgian Railways. Very probably, M. Ronval was able to give valuable information concerning schedules for important trains carrying troops, prisoners, war materials, and other valuables. Travel schedules for strategic materials and local weather information were two of the typical subjects of traffic carried by the Parasets. Remember, there were no weather satellites in those days.

The metal-cased sets popular with replicators apparently came somewhat later. These sets are sometimes referred to as "cash box" sets because of the size of the outer case. Figure 4 [7], courtesy of SM7UCZ, is an example. Its origin and original user are unknown. Note that the valves are carried in the top of the case and installed each time the set was to be used. Otherwise, the outer case would have to have been much deeper and therefore larger. The Paraset schematic also apparently evolved slightly over time, as can be seen by comparing the early schematic of Figure 1 with the later version in the companion article on replicating the Paraset. Differences are minor and involve power circuitry feeding the receiver and small changes in the transmitter.

Acknowledgements

Virtually all of the information presented here comes from the archives of the Paraset Club (http://www.theparasetclub.co.uk/), a small group of some 70 enthusiasts committed to honouring the memory of the design and manufacturing team who created the Whaddon MkVII "Paraset" radio equipment and the Special Agents who used it for clandestine operations in WWII. Readers interested in more information concerning the Paraset are encouraged to visit the IK0MOZ website mentioned earlier and/or contacting the Paraset Club via its website.

References

1. Pidgeon, Geoffrey. *The Secret Wireless War,* published by Arundel Books, 2008. (Distributed by ARRL.)

2. Personal communication from Geoffrey Pidgeon to Secretary of the UK Paraset Club.

3. Figure 1 photo supplied courtesy of Ken Gordon, W7EKB.

4. Austin, Brian, GØGSF. "HF Propagation and Clandestine Communications During the Second World War," *Radio Bygones,* No. 120, August-September 2009.

5. Figure 2 photo supplied courtesy of Johnny Apell, SM7UCZ.

6. Figure 3 photo supplied courtesy of Dr. Eric Evrard.

7. Figure 4 photo supplied courtesy of Johnny Apell, SM7UCZ.

A Frequency Counter Project

Dieter (Diz) Gentzow—W8DIZ w8diz@tampabay.rr.com

...from concept to a finished product

So Brian Murrey, KB9BVN, the current Editor of the QRP-ARCI *QRP Quarterly*, emails me and asks if I was available to write an article for the *QQ*. Since Brain is an infamous member of the Flying Pigs, how could I refuse! Having never officially "published" anything formal, I decided to go all out and write a series of articles describing how to take a project from concept to finished product based on empirical experiences of yours truly.

The Project

Why a frequency counter? It just happened to be the project *du jour* when KB9BVN asked me to contribute to the *QQ*. I designed an early prototype 3 years ago and therefore do not expect any major engineering problems placing the design into production.

The Frequency Counter project will proceed through the following steps:

*1. Install a version of Linux (called MINT) on a PC and become familiar with Linux. Linux Mint is an Ubuntu-based distribution whose goal is to provide a more complete out-of-the-box experience by including browser plug-ins, media codec's, support for DVD playback, Java and other components. It also adds a custom desktop and menus, several unique configuration tools, and a web-based package installation interface. Linux Mint is compatible with Ubuntu software repositories.

*2. Install ATmel tools on Linux for development, including a short course in Assembler Language. Learning by doing, a beginner's project to make an LED blink exactly once per second.

*3. Design a Freq Counter and create a schematic using free tools from http://expresspcb.com

*4. Develop the Freq Counter software (in ASM) under Linux using the free AVRA Assembler/Compiler

*5. Build a prototype frequency counter.

*6. Design a Frequency Counter printed circuit board using free tools from http://expresspcb.com

*7. Provide a complete Frequency Counter Kit for those folks that do not want to homebrew this project.

I expect that this project will span 3 or 4 issues of the QQ, with additional documentation published at http://w8diz.com/qq-fc-project and possibly mirrored elsewhere. (Fig. 1.)

Install Linux Mint

First, I assume that you have a PC/Laptop running Windows. I also assume that you have another PC available to be dedicated for this project. Even though you can have a dual boot PC with both Windows and Linux, I do not recommend it for THIS project. If you wish to NOT install Linux, you will be able to follow this series of articles, installing various software tools for developing the project using a Windows PC.

Figure 1

Figure 2

OK, let's get started installing Linux Mint version 7 code named Gloria. I will provide my version of install instructions in this article. There are also official install instructions from the developers of Linux Mint, available at:

http://ftp.heanet.ie/pub/linuxmint.com/stable/7/user-guide/english.pdf

You will need to download an ISO installation file from:

http://ftp.heanet.ie/pub/linuxmint.com/stable/7/LinuxMint-7.iso

The ISO file is almost 700 Megabytes and depending upon your internet connection, may take several hours to download. You may also purchase an install CD. Vendors for these CDs advertise on http://distrowatch.com/. Note that Distrowatch.Com

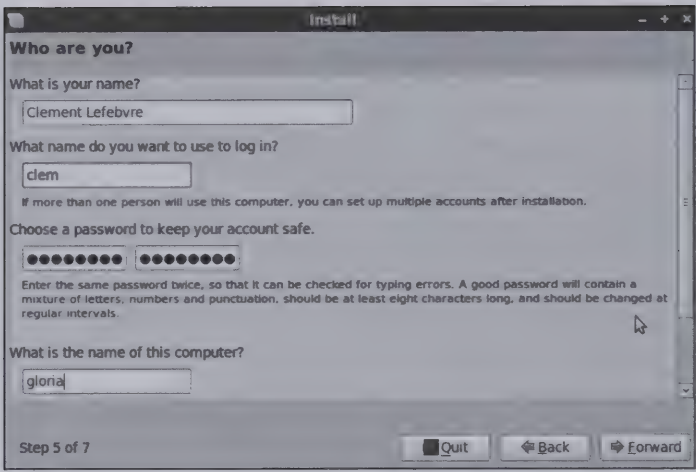


Figure 4

Figure 5

is an excellent web-site for information on the top 100 versions of Linux. Linux has hundreds of versions if not thousands. I am also making available a Linux Mint 7 installation DVD (not CD); see NOTES at the end of this article. (Fig. 2.)

Place the Linux Mint ISO Distribution CD/DVD in the optical drive of your dedicated Linux PC and restart the computer. If your PC does not boot from the CD/DVD, it is probably because your BIOS is not set to boot on CD. Restart the computer and press F1, F2, Delete, or Escape (or whatever key lets you enter the BIOS configuration) and change your BIOS settings to tell your computer to boot from its CD drive. Once the initial boot screen is displayed, the PC will take about 2 minutes to finish booting Linux Mint. At this stage Linux Mint is not installed on your computer, it's simply running from the CD. (Fig. 3.)

The system you have in front of you is, however, almost exactly the same as the one you will have on your computer after the installation is finished. Have fun with it and see if you like it. Bear in mind that it's extremely slow because it runs from the CD. Once installed on the hard drive, Linux Mint is much faster. When you are ready, double-click on the "Install" icon located on the desktop. The Installer appears; answer all the questions; the default answers are mostly correct. The installer will now ask you where to install Linux Mint (on which hard drive, in which partition, etc.). I recommend you select the default "Use the entire disk" even if you have an existing partition on the Hard Drive. When the partitioning is finished, the PC will display an Install Screen asking for a Name. (Fig. 4.)

Enter your Amateur Callsign. Then enter a login password twice, then click "Forward."

On the next screen, click on "Install." Now go to the fridge and indulge in your favorite beverage while the Install Program installs Linux Mint onto your Hard Drive. The installation should take between 10 and 15 minutes. After the installation is complete, click on "Restart Now." When prompted, remove the CD from the drive, connect your PC to the internet via a CAT5 cable and press Enter.

When prompted, enter your user name and password. (Fig. 5.)

Next, a "Welcome to Linux Mint" screen appears. When the "Opening english.pdf" screen pops up, select "Save File" and click on "OK." After the PDF file is saved to your Desktop, close all windows. Since you are connected to the internet, you should see a open lock icon in the lower right corner of your Desktop. Click on it once. Enter your system password when prompted. Linux Mint is now retrieving all software updates available for your system. When the screen is ready, click on "Install Updates." As of Sept 6, 2009, there are 218 files that need updating. Here is another opportunity for you to head to the fridge and partake of a cold beverage as this update process will take some time. If your screen goes black while the install is progressing, then the screen-saver kicked activated. Move your mouse to active your screen. After about 15 minutes, depending upon your internet connection speed, the update should complete. Click on "Close." Finally, close the "mintUpdate" window. The Lock Icon in the lower right of your Desktop should now display as Locked.

If all went well, then CONGRATULATIONS!

Your PC is now updated with the latest version of Linux Mint and ready to rock-and-roll.

Any addendums and/or corrections to this Linux Mint Install will be available at http://w8diz.com/qq-fc-project/part-1/

Next Article

Install ATmel tools on Linux for development, including AVRA and AVRDUDE. Also, a short course in Assembler Language using the ATmel ATtiny2313-20PU. Learning by doing, a beginner's project to make an LED blink exactly once per second.

Dieter (Diz) Gentzow, W8DIZ, aka WB8QYY before April 2000, has been a licensed ham since 1973. Past employment include Honeywell and AC Nielson. Currently semi-retired, living in sunny Palm Harbor, Florida. You can contact Diz, W8DIZ via eMail at w8diz@tampabay.rr.com

Notes:

http://distrowatch.com/
http://linuxmint.com/
http://atmel.com/products/avr/default.asp
http://www.avrfreaks.net/
Download Linux Mint 7 Gloria User Guide http://ftp.heanet.ie/pub/linuxmint.com/stable/7/user-guide/english.pdf

Download Linux Mint 7 Gloria ISO file at http://ftp.heanet.ie/pub/linuxmint.com/stable/7/LinuxMint-7.iso

A Linux Mint 7 (Gloria) DVD distribution is available from W8DIZ for $3 plus shipping, available at http://kitsandparts.com/store2.php

Additional documentation is available at http://w8diz.com/qq-fc-project/

Addendum to Part 1:

Hardware Requirements

Minimum requirements for a practical and speedy Linux machine are at least 512 Megs of RAM and a 1 GHz CPU, either Intel or AMD. A R/W CD optical drive, a R/W DVD drive preferred. At least one USB-2.0 port and one Serial Port is also preferred but not required. At least a 40 Meg HD. A 3.5" Diskette Drive is not required. A minimum of 800x600 Video capability. LAN and/or WiFi capabilities. Sound capabilities are nice but not required.

Download MINT

Download the Linux Mint ISO installation file from http://ftp.heanet.ie/pub/linuxmint.com/stable/7/LinuxMint-7.iso and then validate the downloaded file by running an MD5 program. A MD5 program is available free from http://download.cnet.com/MD5-Checker/3000-2092_4-10410639.html and from me at http://w8diz.com/qq-fc-project/part-1/md5.zip It works for both Windows and Linux(via Wine). The MD5 value is "64e2a290fb51f8e7a9d058355fe93d0e." Note that there is a MD5 checksum program that is included with Linux Mint installations called md5sum.

Install MINT

Follow the instructions using this PDF file: http://www.w8diz.com/qq-fc-project/part-1/mint_7_gloria.pdf

ExploreDesktopMenu Place your Mouse Cursor over the word Menu in the lower left corner of your Desktop. The pop-up should display your Linux Mint version number. Now click (once only) on the word Menu. Your Linux Mint Menu should pop-up. Click on Favorites or All applications in the upper right corner of the Menu; Repeat. These are your two Views of the Linux Mint Menu. You can add or remove applications to and from the Favorites Menu by right-clicking the Menu application and selection the desired action. Look at the Filter: input field at the bottom of the Menu. Type the word music in the input field and notice that as you type, the available Menu options become limited until you only have menu options that include the word music.

Desktop ICONS

All installed programs are available to run from the Menu In addition to the Menu, you may wish to install Icons on the bottom toolbar or on the Desktop. Activate your All applications menu. Click on Internet, drag the Firefox Web Browser to the bottom toolbar. Repeat but drag the icon to your Desktop. To activate Firefox from the Desktop, double-click it. To activate from the toolbar, just click it once. Right click any Icon to manage it. Speaking of Firefox, here is a tip to prevent accidental closing of tabbed browser windows: Activate the Firefox Browser and enter about:config in the URL input field. In the Filter: field, type tabs, then double-click browser.tabs.closeButtons and change the value from one to zero.

Terminal

The Terminal program is similar to the u$ Windows "CMD" or DOS command. By executing Linux commands through a Terminal window, you have full control of your Linux PC. Activate your All applications menu. Click on Accessories, drag the Terminal icon to the bottom toolbar. Click on the Terminal icon once. A window should pop-up, ready for you to type a command at the "$" prompt. Note that all commands and file references are case sensitive. help is not the same as Help. Try the following commands: [whois arrl.org] [ls -la] [pwd] [stty -a </dev/ttyS0]. The last command checks the status of your COM1 serial port.

Screen Captures

Hit the Print Screen key to take a screenshot of the whole screen Alt Print Screen takes a screenshot of the current window. These screenshots may be saved to your Desktop or elsewhere and then edited using the included image editor called gimp.

Install WINE

Wine allows you to run Windows software on Linux. You can read about Wine at http://www.winehq.org/ To install Wine, click on the Menu in the lower left corner of your Desktop. Under System, click on Package manager When prompted; enter the Linux Mint system password. Type the word Wine into the Quick search input field at the top of the screen. Select the Wine package by clicking in the Wine box and in the pop-up, select and click on Mark for installation Now click on Apply in the tool bar near the top of the screen. When the pop-up Mark additional required changes shows, click on the Mark button. Again, click on Apply in the tool bar near the top of the screen. When the pop-up Apply the following changes shows, click on the Apply button. The Package manager will now install Wine. When the pop-up Changes applied shows, click on the Close button. Now close the Synaptic Package Manager window. Reboot your Linux Mint PC by clicking on the Menu, under System, click on Quit, in the pop-up, click on Restart. Wine is now installed on your Linux Mint PC.

Install Printer

My Printer is a BROTHER Model MFC-8460N. It prints, copies, scans, faxes and connects to the Linux Mint PC via a CAT5 LAN(local area network) cable. Click on Menu followed by System Control center. Under Hardware, click Printing and select the New icon. Now select the connection type. In my case I selected Network Printer and saw my Brother printer listed. Double click your printer type and the system will search for the correct drivers on-line. Follow the instructions to finish the installation. Print a TEST PAGE to verify the install. To install software to activate the Scanner portion of my printer, I installed a program called XSane Install XSane by following the instructions for the Wine install.

Install ExpressPCB

ExpressPCB is a free Windows schematic capture and PCB layout program that is available from http://expresspcb.com/ExpressPCBBin/ExpressPCBSetup.exe. ExpressPCB runs on Linux using the Wine program installed in the topic above. Download ExpressPCB for XP, 2000 & NT to your Desktop. To install the expressPCB programs, you must first have Wine installed on your Linux Mint PC. To start the installation of expressPCB, run the Terminal program. Click on Menu, click on Terminal located under System. At the "~ $" prompt, type cd Des, then hit the Tab key. Notice the command line auto-completes to display cd Desktop/ Now hit the Enter key. At the ~/Desktop $ prompt, type wine Ex and hit the Tab key. At this point, Wine will start the installation of expressPCB. Install using the default options. When the installation is complete, close the Terminal program. You should now notice 4 new icons on your Desktop. Delete the 2 icons named ExpressSCH.lnk and ExpressPCB.lnk. Click each icon once with the mouse and hit the Delete key. To test your installation, double-click the ExpressSCH.desktop or ExpressPCB.desktop icon. A pop-up may show; Untrusted application launcher; click on the Launch anyway icon. Instructions for ExpressPCB and ExpressSCH will be available in a future chapter. Limited instructions are available from the program's Help menu.

Install AVRA

AVRA is a free advanced AVR macro assembler used to write and compile code for the ATmel line of AVR microcontrollers. To install AVRA, use the same procedure that you used to install Wine. Note that you do not need to reboot the PC. To test AVRA, open a Terminal window and type avra at the prompt and hit the Enter key.

Install AVRDUDE

AVRDUDE is a free program used to upload and download AVR code files between your PC and an ATmel AVR target (in our case the Freq Ctr). To install AVRDUDE, use the same procedure that you used to install Wine. Note that you do not need to reboot the PC. To test AVRDUDE, open a Terminal window and type avrdude at the prompt and hit the Enter key. ●●

Operating QRP in Major Contests

Gary Breed—K9AY k9ay@k9ay.com

All of you know how much fun QRP contests can be—the ARCI Spring and Fall QSO Parties draw lots of participants, the Homebrew Sprints are highlights for many QRPers, and all the others have their big fans. Well, if you like these, maybe you should try your QRP signals in the "big" contests. I've included a list that includes some of the major contests, that is, the ones with the highest participation levels.

Major Ham Radio Contests

Contest	Length	Month	Mode
North American QSO Party	12 hr	Jan, Aug	CW, SSB
CQ Worldwide 160M	48 hr	Jan, Feb	CW (Jan) SSB (Feb)
ARRL DX	48 hr	Feb	CW, SSB
CQ WPX	48 hr	Mar, May	SSB (Mar), CW (May)
IARU Radiosport*	24 hr	Jul	CW, SSB, Mixed
Worked All Europe	48 hr	Aug	CW, SSB
CQ Worldwide DX	48 hr	Oct, Nov	SSB (Oct), CW (Nov)
ARRL Sweepstakes	30 hr	Nov	CW, SSB
ARRL 160M	40 hr	Dec	CW
ARRL 10M	48 hr	Dec	CW, SSB, Mixed

Notes: There are many other contests of substantial size—these are the ones with the greatest participation in most years. ARRL Sweepstakes is limited to US/VE operators only. ARRL DX does not score QSOs among US/VE participants or DX-DX QSOs. All others allow worldwide participation, although scoring often varies by the location of stations worked.

**In 2010, the IARU Radiosport contest will also be the competition event for the World Radiosport Team Champioship (WRTC).*

The Attraction of Contests

What is it about ham radio contests that attracts so many enthusiastic entrants? Here is my person list of things that contests offer; I'll bet you can find several things that fit your own ham radio interest and attitude!

The Challenge of Competition

Human beings are a competitive sort, whether in sports, politics, careers... or ham radio. Ham radio contests provide some very interesting types of competition, combining individual skills with collective cooperation. Very few other competitions allow the same mix of experience level and station capabilities.

Major contests draw the best contest operators in the greatest numbers, which sets them apart from smaller events. Can you think of any other sport that allows a complete beginner to not only join in alongside, but actually influence the score of the world's top competitors?

Improve Operating Skills

Many inexperienced contesters emphasize the development of their skills—building code speed, focusing on signals in the presence of noise and interference, learning about propagation. While contests are not the only place to gain this kind of knowledge, they offer an excellent opportunity to measure it.

For many hams, their first contest-style experience is Field Day. I've heard plenty of stories of how one 24-period greatly improved a new ham's code speed and ability to hear more signals (phone and CW) on a crowded band. Field Day is also a good example of how we can learn with the help of more experienced operators.

Improve Technical Capabilities

As we gain a bit of experience and interest in contests, we inevitably yearn for bigger and higher antennas, a rig with more selectivity and dynamic range, or a more convenient operating setup for logging, antenna switching, etc. These needs are most evident in the major contests, where there are more and louder signals on the bands.

Not all of us are willing (or able) to develop a highly competitive contest station. And that's OK! Contests are first and foremost personal activities—*you* get to choose how seriously to compete. One of the individual challenges can be improving a simple antenna system. Different wire antennas can be compared side-by-side if you have the room to install them. At the very least, a new antenna's performance in a contest will give you a good idea whether it is working better than the old one.

A few years ago, I had three different 80M antennas in three successive years for Sweepstakes (QRP class, of course). Surprisingly, I made about the same number of QSOs with each, but saw some interesting patterns—the inverted-Vee had more close-in QSOs, the delta loop had a clear emphasis in its broadside directions, and the vertical ground plane had the most distant QSOs of the three.

Contests are also a good place to evaluate equipment. Does that new homebrew radio have enough selectivity and dynamic range? Can you conveniently switch antennas with that new relay box you made? Quite often, I've chosen my next project by recognizing some part of my station that just didn't perform well enough in the high intensity atmosphere of a contest.

Personal Challenge

Contests include hams at all levels of skill, experience and station capabilities. The vast majority of contest participants are not potential winners at the world or continental level. Instead they focus their efforts on winning at the call district or state level... or to be the best in their local club... or beat their pal across town... or just to do better than they did last year.

One way hams with smaller stations try to excel is in single-band contesting. With high activity in major contests, there are plenty of stations available to keep an operator busy on one band—and if the band closes, a little sleep makes it a lot easier to get through the entire event! Single-band contesting also allows a ham with a modest budget build a competitive station for his favorite band.

Team Spirit

In a contest, all participants are not just competing, they are also cooperating. They work to share busy bands. Just as traffic doesn't move in a traffic jam, QSOs are harder for everyone when the bands are too crowded, so contesters spread out—but only just enough!

Also in the category of teamwork are local and regional contest clubs. Just like QRPers share notes on our particular contests and operating activities, hams who like major (and minor) contests often are active in a contest club. These clubs are outstanding resources to help in those improvement categories I mentioned earlier in this article.

Lots of Activity

For most hams who are not among the top contesters, the #1 draw of a major contest is the high level of activity. There are lots and lots of stations to work, and they all want your QSO. At the very least, contests are an opportunity to get on the air and fill your logbook. And sometimes, even a die-hard ragchewer likes a change of pace, turning up the speed and operating with a different attitude.

I'm not the only one who has noticed that contest participation has actually increased along with the average age of ham population! There are many hams with plenty of experience, a bit more time on their hands, and a willingness to budget a little more money for their favorite hobby. These active hams are looking for more excuses to operate, and several major contests have recently had all-time record numbers of entries.

Also, it certainly doesn't hurt the image of ham radio to have the bands filled with signals. "Use it or lose it" is not a problem on the weekends of major contests!

Make QSOs for Awards

The high activity level of major contests is a boon for certificate and award hunters! Worked All States and DXCC are most popular, of course, but there are many fascination awards available worldwide. With all those stations on the air, you can complete the requirements for enough certificates to wallpaper your entire shack if you wish!

Do want to earn a couple hundred "1000 Miles Per Watt" (KMPW) awards in a weekend? Get into a big DX contest! In a contest like CQWW DX, running 3 watts makes every US-to-Europe QSO eligible for KMPW. Even with a simple wire antenna, you will work enough DX stations to satisfy your craving for this award!

"Full Immersion" in Ham Radio

I call this *contest therapy*. At various times in our lives, we can get very busy with careers, family and personal activities other than ham radio. Setting aside a weekend now and then (or just an evening for a Sprint) gives you something to look forward to. Then, the intensity of the contest helps block out anything that might be troubling you at the time!

When you get so harried with other things that you can't even get your station prepared for a contest, the major contests offer something else—multi-operator entry categories. Two, three or more hams can gather at the best station among them, and share both operating time and off-time camaraderie. This arrangement is also a great way for a less-experienced contest operator to get valuable instruction and on-air experience.

Contesters Will Hear You

Every once in while, you may hear some grumbling from a contester about having to dig out "all those wimpy QRP signals." Trust me, any ham with this attitude will never become a top contester! Every semi-ambitious contest competitor wants every QSO he or she can get, no matter how hard it is to dig it out of the noise and QRM.

I can also vouch for the fact that the weakest signals are often not QRP—they are more often coming from locations where there is poor propagation, from antenna-challenged stations of all power levels, or simply arriving off the side or back of the beam!

Partly because I have lots of QRP experience, I actually seek out weak signals, no matter what power level I'm competing at. Plenty of experienced contesters have the same attitude. There are two main reasons why this makes sense:

1) That weak signal station probably won't be able to work many stations. So if I can hear and work him, and my competitors do not, it means I'm one more QSO ahead of them.

2) Of course, that weak signal might be from far away, and a new DX multiplier!

The biggest compliment you can give me is sending an e-mail after a contest to tell me I'm the farthest station you worked, or the only station you worked in my part of the country.

What QRPers and Serious Contesters Have in Common

You might not think that QRP operators who "think small" share similar interests with hams who have invested many thousands of dollars (or Euros, Pounds, Yen or Rubles) into big antennas and lots of equipment, but there is...

First, contesters and QRPs are among the most technically competent groups of hams in the hobby. The most serious members of both groups have the goal of achieving the best technical capabilities for their stations—even if they differ in the specific objectives.

I might note that technical professionals have the same variation in objectives. There are engineers attempting to design the cheapest possible cell phones and TV sets (that still work well), while others are pursuing cost-no-object performance for spacecraft, military countermeasures or high energy physics research. If you put these guys in the same room, they have plenty of common interests to talk about!

Also, many elite contesters truly appreciate QRP as test of station and skill. A surprising number of them have given QRP a try at various times over the years. I know several of them who do one of the things I enjoy—when we decide to operate casually in a particular contest, we start by turning the power down to five watts. Sometimes it's so much fun we get hooked and operate much longer, and more seriously, than we originally planned.

Enough philosophy; let's look at some strategies for specific contest types.

Overall QRP Techniques

Different power levels, antenna capabilities and geographic location will have some differences in operating methods. To develop the methods that work best for you and your station, start by trying the following proven techniques for QRP operation on the busy bands of a major contest:

Don't send "/QRP"—First, the extra characters make your call longer, and contests are all about making contacts as rapidly as possible. Although there are a handful of stations around the world who

actually look for QRPers, the vast majority of contesters simply consider you to be just another signal in the passband, and will never know you are QRP (except in Sweepstakes, where your "Q" precendence tells them).

Learn efficient Search & Pounce habits—"S&P" means tuning the bands and calling those stations who are CQing and running stations one after another. Try to figure out quickly if the station you hear has the beam pointed another direction, e.g., is he working other stations in your area, or just those in some other direction? Also try to gauge the strength of propagation. With big antennas, many "big gun" stations are fairly loud even when conditions are so-so, but with time and experience, you will be able to judge how good the path is. Then don't waste time calling stations that are not likely to hear you.

Act loud when things are working well!—Good conditions raise all signals, but help QRPers the most by lifting our signals out of the noise. Also, you may have a really good antenna on one or more bands, which can make you louder than many higher power stations with lesser antennas. When conditions are good and you are on the right band, call CQ, turn up the code speed, and do all those other things that the "big guns" are doing. It will increase your QSO production!

Operate "against the trend"—By this, I mean things like emphasizing the second-best band that's open. If 20M is hot, it will become very crowded, but 15M might be open as well, and may be much less crowded. Another hint that is most effective in domestic contests is to work hard during periods of less activity, such as late night hours and midday. You'll really want to work hard late in the contest when many stations are begging for QSOs! This is an essential QRP tactic.

"Domestic" Contests: ARRL Sweepstakes, North American QSO Parties

Contests with all (or nearly so) activity in your own country or continent are different than DX contests. Propagation is via shorter paths, signals are usually stronger, and the total number of participants may not be as large.

Antenna choices—Domestic contests can be operated successfully with modest antennas, including the common tribander at 60 or 70 feet. Even the classic dipole will be highly effective, as long as it is installed at a height that provides an optimum takeoff angle, and is clear of objects that can affect its radiation pattern. If stations are located in different directions, you may benefit from installing a second dipole for key bands, oriented a right angles to the other one. On the low bands, you may want to have both a dipole and a vertical to reach stations at different distances (and takeoff angles).

Strategies—Sweepstakes and NAQP have mandatory "off" time. Choosing the right time can help a lot. While a high power station will benefit from the high energy level and activity right at the start of a contest, a QRPer will often benefit from the slower rate of activity in the middle of the contest.

Also, in a domestic contest, a QRP signal is not necessarily weak, just "less strong"! Remember, if those high power guys are 40 over S-9, your 5 watts (and decent antenna) may still be well over S-9.

DX Contests: CQWW DX and WPX, ARRL DX, WAE (and others)

Successful (or just enjoyable) QRP operation in a DX contest requires some combination of good antennas and good propagation. Those long-distance QSOs simply need it! If those things are not present, you may need to be satisfied with fewer DX QSOs. However, when conditions are good, it is sometimes astonishing what can be worked with five watts!

Antenna choices—For DX, there is no substitute for "bigger" and "higher." One way to do this is to borrow a much larger station from a nearby ham who is not participating in that contest. Perhaps you can operate QRP in a CW contest at the QTH of a pal who primarily operates phone.

Another option is to go portable and operate where Mother Nature provides the height. Some years ago, I operated a couple CQ WPX CW contests during Memorial Day weekend camping trips in the Colorado mountains. One of those resulted in the top QRP score from the "Tenth" call district.

Strategies—Review the list I presented before. In DX contests, it is especially important to gauge the propagation, to be on the right band at the right time. Also, "big guns" do not hear equally well. For example, some contest club stations are located in a noisy industrial district. Figure out which ones are not hearing well, and don't spend too much time trying to get through.

"Specialty" Contests: ARRL, CQ and Stew Perry 160 Meter Contests, ARRL 10 Meter Contest

(These comments also apply to single-band entries in all-band contests.)

It is interesting that there are single-band contests for the highest and lowest frequency HF bands. I suppose it is because propagation is most variable on those bands, and a contest is one way to keep activity high when propagation is low. That is certainly the case right now, with the extended Solar Minimum we have been experiencing. Personally, I think it's great, because I'm a huge fan of 160M, but the relatively poor conditions on the high bands are frustrating to most hams.

Antenna choices—On 160M, you need a fairly good transmit antenna. An inverted-L, or a vertical made from the feedline and top wires of your 40M dipole, are going to get lots of QSOs. Be sure there are plenty of radials!

Next, it may sound odd, but being able to hear well is even more important than being loud on 160M. This is because the limitations of a high noise level are often greater than the space limitations for a large transmit antenna. There are a number of options, so study the available literature.

On 10M, the size of the antenna is the inverse of the conditions! When 10M is wide open, you can work the world easily with five watts and a dipole. When the band is dead, 1.5 kW and stacked Yagis on a 200 foot tower may not be enough!

Strategies—The 160M and 10M contests are the favorites of many hams. They compress all contest activity into a small space, which creates an exciting melee at the start! Then, as stations work each other, the intensity slows as they all seek out new, often weaker, stations to work. QRP can get through to somewhere at any time, but it really shines after the initial rush has passed.

Summary

Hopefully, my ramblings on the subject of QRP and major contests has helped you learn a bit more about the subject. The QRP category is popular in these events, for the same reason QRP is popular—it's lots of fun to do more with less! ●●

Jeff Hetherington—VA3JFF

contest@qrparci.org

Some people say that a contest reporting column has the possibility of becoming repetitive. Contesting is repetitive itself with all those 59(9) reports and exchanges of States/Provinces/Countries or Serial Numbers. Contest results are reported in this column each quarter, many times the callsigns of the regulars are typed over and over again, and there is nothing new to report. Being a contester as well as the author of this column, there is one more repetition that is become a bit of an annoyance to me, and that is terrible band conditions, and no sunspots on contest weekends! Once again this quarter we were plagued by poor conditions on our contest weekends, as can be seen in the soapbox comments from the participants. On a bright note however, this past year has also seen a bunch of repetitive comments in those same soapbox comments about the number of new callsigns that are heard during the weekend. Hopefully these newcomers will return next year to see better conditions and just how much fun these QRP-ARCI contests can become when the bands are really hopping!

The Hootowl Sprint contest is one of those contests that really can challenge the operator in the best of conditions, and this year the challenge of the propagation added to the frustrations of many. As is often the case immediately following a major contest like the CQ WPX CW, the bands do go quiet just before the sprint begins. Toughing it out to win this contest, especially if you have also been competing in the WPX CW, can be a true test of endurance. Bob Patten, N4BP battled through these challenges to take the crown for 2009 with his 49,896 points out distancing the three way battle that followed him. Al Scanandoah, K2ZN took second spot with 38,024 points, Randy Hargenrader, K4QO scored 36,455 points for third place and just behind them in fourth spot was Paul Kirley, W8TM with 33,425 points. The top five was rounded out by Arnold Olean, KØZK with a total of 27,650 points.

2010 QRP-ARCI Contest Schedule

2 January 2010	Pet Rock Sprint
7 February 2010	Winter Fireside SSB Sprint
13 March 2010	HF Grid Square Sprint
3 - 4 April 2010	Spring QSO Party
30 May 2010	Hootowl Sprint
26 - 27 June 2010	milliWatt Field Day Contest
11 July 2010	Summer Homebrew Sprint
21 August 2010	Silent Key Memorial Sprint
11 - 12 September 2010	VHF Contest
16 - 17 October 2010	Fall QSO Party
2 December 2010	Top Band Sprint
19 December 2010	Holiday Spirits Homebrew Sprint

This led into one of the most popular outings of the year for many operators across North America, the ARRL's Field Day. For QRP operators, this is really the chance to show what you can do against the big boys, and the scoreboard usually shows many QRP groups among the overall leaders. This year the scoring difficulties that many operators in the milliWatt Field Day contest were virtually eliminated as the scoring was brought in-line with the ARRL requirements and allowed for the power multipliers that we are used to seeing in the QRP-ARCI contest offerings. Our top scoring group was the Florida Contest Group, N4BP with 13,496 points followed by Dana A. "Mike" Michael, W3TS with 7,784 points. The Forstyhe Amateur Radio Club, W4NC with 6,531 points, John & Kent, NØEVH with 4,494 points and Dean Manley, KH6AA with 3,122 points rounded out our top scoring entrants.

The Summer Homebrew Contest probably experienced the most unique operating conditions. Again, the contest was preceded by a major international contest, the IARU HF World Championship, and the conditions during that contest seemed quite favourable. Many QRPers were active during the IARU contest with good results, but in the few hours after the IARU contest ended, and before the Homebrew Sprint began, something in the ionosphere changed. Taking top spot once again was Bob Patten, N4BP with an impressive total of 62,437 points that kept him ahead of Randy Hargenrader, K4QO and his second place total of 49,295 points. John T. Lainey III, K4BAI scored a third place finish with 43,610 points, while Barry Ives, AI2T with 26,762 points and Randy Foltz, K7TQ with 24,110 points battled it out to get into the top five.

The QRP-ARCI Contest Championship for 2008 was also finally finalized. After a bit of score re-calculating, and double checking, we can now officially announce that Bob Patten, N4BP has won his second consecutive Championship. The scoring system allows for each operators top six individual contest results to be scored, giving a top possible score of 228 points. Bob scored the first Perfect Score in the QRP-ARCI Contest Championship, and in three additional contests that he had entered, he scored another win and two second place finishes! A truly dominating performace in 2008, but can he keep championship in 2009, only time will tell as there are still three contests to go. The 2008 running for the Contest Championship featured 32 operators that met the eligibility requirements of entering at least three contests. There were an additional 25 operators that entered two contests, and with just one more entry they would have been eligible for the Contest Championship. 2010 is just around the corner, and the next running of the QRP-Contest Championship will continue as it has in the past.

The only changes for 2010's contest lineup, is the addition of a Multi-Operator category in the Spring QSO Party and the Fall QSO Party. Both of these categories are

often used to test equipment going into the Spring and Fall contest seasons, and many QRPers are beginning to enjoy the camaraderie and company of operating with friends. The Spring QSO Party will be on April 3rd and 4th in 2010, so make your plans now to get those stations on the air. Multi-Operator Single Transmitter or Multi-Operator Multi Transmitter entries will both be accepted. Good Luck to everybody for 2010, and let's hope the Sunspots finally start to make their much anticipated return.

Until next time, keep your power down and your QSO rates up.

—73/72, Jeff, VA3JFF

Hootowl Sprint Top 5 Results

N4BP	49,896	Bob Patten
K2ZN	38,024	Al Scanandoah
K4QO	36,456	Randy Hargenrader
W8TM	33,425	Paul Kirley
KØZK	27,650	Arnold Olean

Hootowl Sprint Soapbox

Awkward start with several people telling me contest was over. "Not WPX" and "QRP Test" from me didn't help.—**N4BP**

Plenty of strong signals, but I was too tired to work the entire 4 hours. At least I rememered to show up this year!—**K2ZN**

Conditions were horrible! QRN on 40 and 80 was unbearable.—**K4QO**

Operation from salt marsh at Parsons Beach, Kennebunk, Maine. Small bridge over tidal salt water.—**KØZK**

Another fun time thanks to the QRP-ARCI! 40 was once again the "money band"; but conditions were decent and it was nice to hear stations spread out between 7.030 and 7.040.—**W2LJ**

Except for single 20m QSO @ 200 mW, rest of contest run at 100 mW. Hats off to those able to pull weak signal out of that QRN—and to several other who made a noble try.—**K4KSR**

It was good to hear 20m open. My ears still hurt from the QRN on 40m.—**W5ESE**

Following the CQ WPX contest not much action heard in Arizona—**N7RN**

I had fun … which is what it's all about right? I just got this rig … and been away from CW for a long time … but working on a comeback, hi hi.—**KA2CAQ**

milliWatt Field Day Category Winners

VE3VM	2,254	1A-Battery
VA3SG	1,694	1B
W3TS	7,784	1B-Battery
KH6AA	3,122	1D
N4BP	13,496	1E
W4NC	6,531	5A

milliWatt Field Day Soapbox

Ops VE3RCN and VE3CW—**VE3VM**

Ops KØWEW and NØEVH—**NØEVH**

I had a lot of fun out on the Appalachain Trail by myself. Just wish I had more time to spend on the air and stay overnight.—**WB3AAL**

Used the new club call KH6AA for the first time.—**KH6AA**

I just wanted to see what I could do with the home station in 2 hours.—**W1XV**

Not much time this year. I just gave my K1 a bit of a workout from home—**KD2MX**

Ran K3 at 5W from solar charged 110A/H marine battery. Station performed flawlessly, but got shut down for a while due to thunderstorms. Spent last hour on 6M SSB to test new 5 el Yagi which produced 100 QSOs.—**N4BP**

With conditions as bad as they were here last year I said I'd probably wait about 3 years before trying another all QRP Field Day again. But I went ahead and did it anyway. As it was last year, 40 was very QRN and it was a struggle over a lot of time to get 32 Qs. Probably should have stayed with 20 mostly. Conditions on 15 were fair Saturday PM and the band was open for a short while Sunday AM. On 10 no real opening from here in the middle. Once again 20 was the most productive. I'll wait till next year to decide whether I'll do another all QRP field day again. But it was all fun anyway and worked several stations with calls I recognized from other QRP events.—**W5USJ**

IC703 @5 wts to G5RV (40M) and vertical (20M/15M). I always enjoy Field Day. Very hot in NTX this year (~100 deg), so I operated casually from my home shack, but used a couple of 7 ah gel cell batteries to power the station. Next year, I am determined to operate from a remote site. Thanks to all for the QSOs!—**WA5RML**

2008 QRP-ARCI Contest Championpnship Results

Callsign	*Total Score (Max 228)*
N4BP	228
AI2T	175
VA3RKM	172
K3HX	170
KØZK	146
K4KSR	142
N6DIT	136
AA4XX	134
KD2JC	119
W2JEK	98
VE3UTT	94
KØLWV	91
W4FMS	91
WØUFO	84
WA1WQG	68
K4PBY	63
AB8FJ	62
N1LU	61
KN1H	56
WD7Y	45
WB3AAL	44
NU7T	43
K4BAI	37
KD2MX	33
NØEVH	30
WT8M	29
WA5RML	28
NG7Z	27
KD2MU	25
W5ESE	25
N8QE	23
AA5TB	19

I originally planned to do a 1B operation from a mountaintop in Anza-Borrego Desert State Park. An illness caused me to have to cancel those plans and work from home instead. I used my K2 with its internal battery until that got too low, then switched over to my HB-1A, which was going to have been my backpacking rig. The HB-1A sure has a nice receiver on it, but you can't beat the filtering on that K2. For 80 meters I used my MFJ Cub, which still amazes me when it makes so many contacts. My operating time was cut short when I went to visit my local radio club at their Field Day site. I got pressed into service on their 20m CW station, as apparently there was nobody else around to do CW. It was certainly fun, but it is also a sad comment on the state of CW today. The radio they had set up for the CW station was a TS-2000, and I came to my own personal conclusion that it is a poor

Hootowl Sprint Results										
Call	QTH	Score	QSOs	PWR	PTS	SPC	Bands	MULT	Bonus	Rig + Ant
N4BP	FL	49896	48	< 5W	216	33	20/40	7	0	K3 + Cushcraft A4S, 40/80 Armadillo Trap Dipole
K2ZN	NY	38024		< 5W	194	28	ALL	7	0	Omni V.9 + Dipole, TGM MQ-2
K4QO	SC	36456	45	< 5W	186	28	ALL	7	0	Orion + 500ft Loop
W8TM	OH	33425	46	< 5W	191	25	40/80	7	0	K3 + Inverterd Vee
KØZK	ME	27650	37	< 5W	158	25	40	7	5000	K2 + Hamstick on VW Beetle
K4QS	VA	21406	28	< 5W	139	22	40/80	7	0	K3 + Full Wave Loop
W2LJ	NJ	20160	30	< 5W	144	20	ALL	7	0	K2 + G5RV
K4KSR	VA	18900		< 250mW	90	14	ALL	15	0	K1 + Windoms, Dipole
K4BAI	GA	18396	33	< 5W	146	18	40	7	0	FT1000MP + Zepp
W2JEK	NJ	12376	22	< 5W	104	17	ALL	7	0	
AA4W	FL	10472		< 5W	88	17	ALL	7	0	
KN1H	NH	10304	19	< 5W	92	16	ALL	7	0	FT-817 + 380ft Wire
K9IS	WI	6825		< 5W	75	13	ALL	7	0	IC703 + 80m Loop
WQ8RP	MI	6097	17	< 5W	67	13	40	7	0	Drake TR-7 + 40m Dipole
W1PID	NH	1470		< 5W	42	5	ALL	7	0	IC703 + Windom OCF Dipole
KD5KJ	AR	1260	6	< 5W	30	6	40	7	0	FT-857D + G5RV
WA1GWH	NY	980	7	< 5W	35	4	80	7	0	TS-520 + 1/4 wave wire
W5ESE	TX	560	4	< 5W	20	4	20/40	7	0	
N7RN	AZ	455	5	< 5W	13	5	20/40	7	0	IC756-ProIII + 3 ele Yagi, Windom
KE5ZFZ	OK	420	4	< 5W	20	3	20/40	7	0	HW-9 + Tak-Tenna
AB8FJ	OH	315	3	< 5W	15	3	40	7	0	Ten-Tec Argonaut II + Endfed Random Wire
NØNBD	KS	252	3	< 5W	12	3	40	7	0	PFR-3 + Norcal Doublet
NØEVH	MO	140	2	< 5W	10	2	40	7	0	K3 + Loop
KA2CAQ	NY	98	2	< 5W	7	2	40	7	0	DSW-II + 40m Dipole

CW rig. I take my share of the blame and will do more next year with the local club to promote CW and to get a decent station set up. Lesson learned!—**WA6L**

Participation limited, so had great fun seeing what 100 mW would do. Sure doesn't run the battery down—**K4KSR**

KJ4IC Club Trustee—**W4NC**

Summer Homebrew Sprint Soapbox

20m seemed to open for brief periods and then go dead. Participation seemed very light. GM3OXX had a huge 1W signal on 20m. Worked several CA stations, perhaps skip was too long for the east coast population masses. Went to 40m for the last 30 minutes to pick up some mults. Summer static levels were torture after spending hours on the band in the Radiosport Saturday night.—**N4BP**

Conditions on 40 were long late into the contest. It was nice to hear somebody on 15m—**K4QO**

Operated portable from Newtown Battlefield State Park in Elmira, NY, elevation 1440ft. Very quiet location. Blessed with a pleasant day. Threw random wire into the trees; ground rod and batteries.—**AI2T**

First hour was good as was the last one. Others a bit slow. Good to hear many new calls. Had to pull the plug with 20 mintues left for a big thunderstorm.—**K7TQ**

Summer Homebrew Sprint Top 5 Results		
N4BP	62,437	Bob Patten
K4QO	49,295	Randy Hargenrader
K4BAI	43,610	John T. Lainey III
AI2T	26,762	Barry Ives
K7TQ	24,110	Randy Foltz

A big thank you to those who braved the atmospheric noise. Quite a change from the great propagation of the earlier IARU event. We showed this afternoon that QRP can get through even in really bad conditions! Special thanks to AI2T for an 80m contact and bonus just before the deadline.—**VA3RKM**

Conditions were certainly not the best. Very few stations heard at my QTH, whether they were in the contest or not.—**KB3WK**

Nice way to spend a hot afternoon. Thanks to all who worked to dig out my signal, especially GM3OXX!—**W4RYW**

Vacation Portable—**K9JG**

Not much activity, bands very quiet. Still, good to get out in the woods.—**K3HX**

Called CQ on 15m seemingly forever on the MFJ Cub. A call from K4QO was a real thrill. Had a receiver issue on the ATS-3 which reduced its sensitivity. Apologies to anybody that called and I could not hear.—**W5ESE**

Band conditions were awful at my QTH—8 QSOs in almost 3 hours! All were down near the noise level. Thanks to all who participated and toughed it out.—**WA5RML**

Pulled power off truck battery - slung G5RV between two pines out in the boonies.—**N6DIT**

Op: Jim Osborne, WD9EYB - KT9E Portable at Cave Creek Park, Phoenix, AZ.—**K6RXL**

Tough condx here, QRN, QSB.—**KØLWV**

Only my second attempt, but had a great time and was thrilled to snag HP1AC out of Panama!—**N5SPE**

I had planned to operate QRPp but it was obvious from the start that the band conditions would not support it. Can't wait till next event to do some more QRPp.—**K4AXF**

Bands very lousy in GA.—**W4QO**

milliWatt Field Day Results

Call	QTH	Score	QSOs	PWR	PTS	Cat	Bands	MULT	Rig + Ant
VE3VM	ON	2254	161	< 5W	322	1A-Battery	40	7	FT817 + 88ft Doublet
VA2SG	QC	1694	121	< 5W	242	1B	ALL	7	PFR-3 + Vertical
W3TS	PA	7784	556	< 5W	1112	1B-Battery	ALL	7	K2 + 130ft Doublets
NØEVH	MO	4494	321	< 5W	642	1B-Battery	ALL	7	K3 + Doublet
AD7L	OR	2296	164	< 5W	328	1B-Battery	ALL	7	FT817ND + Hy-Gain 18AVT
AA5CK	OK	1750	130	< 5W	250	1B-Battery	ALL	7	K2 + 30ft wire vertical
KIØG	CO	1480	74	< 1W	148	1B-Battery	ALL	10	KX1 + Random Wire
W0RSP	SD	1120	80	< 5W	160	1B-Battery	ALL	7	KX1
WB3AAL	PA	581	50	< 5W	83	1B-Battery	ALL	7	K2 + Black Widow Vertical
NI5X		392	28	< 5W	56	1B-Battery	ALL	7	ATS3B + 40m Delta Loop
KH6AA	HI	3122	223	< 5W	446	1D	ALL	7	K2 + 40/20 2 ele beams, 40m dipole
VE3MGY	ON	530	530	> 5W	530	1D	ALL	1	
W1XV	NH	380	19	< 1W	38	1D	40	10	K3 + Carolina Windom
KD2MX	NJ	308	22	< 5W	44	1D	ALL	7	K1 + Loop
W5FIO	TX	175	16	< 5W	25	1D	ALL	7	
N4BP	FL	13496	1014	< 5W	1928	1E	ALL	7	K3 + 40/80 Armadillo Trap Dipole, A4S, A50S
W5USJ	TX	2380	170	< 5W	340	1E	ALL	7	FT817 + 88ft EDZ and Butternut Vertical
K3HX	PA	1582	113	< 5W	226	1E	ALL	7	K1, Orion
WA5RML	TX	1232	87	< 5W	176	1E	ALL	7	IC703 + G5RV, MA5V
WA6L	CA	896	64	< 5w	128	1E	ALL	7	K2, HB-1A, MFJ Cub
K4KSR		728	52	< 250mW	104	1E	ALL	7	K1 + Windoms, Trapped Dipoles
W4NC	NC	6531	563	< 5W	933	5A	ALL	7	IC706, TS2000, FT817ND, K3 + Loops, Moxons, Vee

Summer Homebrew Sprint Results

Call	QTH	Score	QSOs	PWR	PTS	SPC	Bands	MULT	Bonus	Rig + Ant
N4BP	FL	62437	53	< 5W	227	33	20/40	7	10000	K2 + Cushcraft A4S, 40/80 Armadillo dip.
K4QO	SC	49295	34	< 5W	155	27	ALL	7	20000	K2 + 2 ele SteppIR, 500ft loop
K4BAI	GA	43610	41	< 5W	178	35	ALL	7	0	FT1000MP + TH6DXX, Zepp, Dipole, Inv V
AI2T	NY	26762	15	< 5W	69	14	ALL	7	20000	K1 + Random Wire
K7TQ	ID	24110	29	< 5W	130	21	20	7	5000	K2 + Force 12 C4SXL
VA3RKM	ON	23925		< 5W	85	15	ALL	7	15000	K2 + Verticals and Wires
KB3WK	MD	22440	13	< 1W	62	12	ALL	10	15000	K2 + 3 ele Yagi and dipoles
W4RYW	AL	21200	23	< 1W	106	20	ALL	10	0	K3
K9JG	ME	16568		< 5W	32	7	20/40	7	15000	KD1JV ATS-2 + Inv Vee
K3HX	PA	16510	16	< 5W	62	15	20/40	7	10000	K1 + Homebrew 20/40 fan
W5ESE	TX	15560	4	< 5W	20	4	ALL	7	15000	MFJ Cub, ATS-3 + Horizontal Loop, vert.dip.
W2JEK	NJ	15315	3	< 5W	15	3	ALL	7	15000	OHR-500
K4DZR	TN	14284	12	< 5W	51	12	20/40	7	10000	K2
WA5RML	TX	11813		< 5W	37	7	20/40	7	10000	K2 + 40m dipole, 20m vertical
K9TFC	WI	11260	6	< 5W	30	6	20	7	10000	K1 + Inv Vee, 32ft telescoping mast
N1IMW	NH	11050	6	< 5W	30	5	40	7	10000	OHR-500 + 40m Inv Vee
N6DIT	CA	10560	5	< 5W	16	5	20	7	10000	KX1 + G5RV
KT9E	IN	10315	3	< 5W	15	3	20	7	10000	Oak Hills Explorer II + Voorhees Vertical
AB8FJ	OH	10140	2	< 5W	10	2	20/40	7	10000	DSW-20, SW-40 + End Fed Random Wire
K6RXL	AZ	10140	2	< 5W	10	2	20	7	10000	K1 + 66ft End Fed Wire
W8TM	OH	9660	22	< 5W	92	15	20/40	7	0	K3 + 40m Inv Vee
KØLWV	MO	7280	16	< 5W	80	13	20/40	7	0	IC718 + Longwire Vee, Wire Groundplane
AA5TB	TX	5770	5	< 5W	22	5	40	7	5000	SW-40+ + Inv L
VA2SG	QC	4697	14	< 5W	61	11	20/40	7	0	
KØPC	MN	3640	11	< 5W	52	10	20	7	0	
N5SPE	MS	2835	9	< 5W	45	9	ALL	7	0	Ten-Tec Pegasus + Double Zepp
K4AXF	VA	2800	10	< 5W	50	8	ALL	7	0	Wilderness Sierra + 124ft doublet
W4QO	GA	1260	6	< 5W	30	6	ALL	7	0	K3 + 80m Loop
HP1AC		1008	6	< 5W	24	6	ALL	7	0	

Contest Announcements

E-mail Log Submission:
Submit Logs in plain text format, with a summary stating your Callsign, Entry Category, Actual Power and Station Description, along with score calculation to contest@ qrparci.org

Mail Log Submission:
Submit Logs with a summary stating your Callsign, Entry Category, Actual Power and Station Description, along with score calculation to:

(Contest Name)
c/o Jeff Hetherington, VA3JFF
139 Elizabeth St. W.
Welland, Ontario
Canada L3C 4M3

Results:
Will be published in *QRP Quarterly* and shown on the QRP-ARCI website.

Certificates:
Awarded to the top scoring entrant in each category. Certificates may be awarded for 2nd and 3rd place if entries are sufficient in a category. Some contests award certificates to the top scoring operators in each State, Province or Country.

2010 QRP-ARCI PET ROCK CELEBRATION

Date/Time:
1500Z to 1800Z on Saturday 2 January 2009.

Mode:
HF CW only.

Exchange:
Members: RST, State/Province/Country, ARCI member #
Non-Members: RST, State/Province/Country, Power Out

QSO Points:
Member = 5 points
Non-Member, Different Continent = 4 points
Non-Member, Same Continent = 2 points

Multiplier:
SPC (State/Province/Country) total for all bands. The same station may be worked on multiple bands for QSO points and SPC credit.

Power Multiplier:
>5 watts = x1
>1 - 5 watts = x7
>500 mW - 1 watt = x10
>200 mW - 500 mW = x15
>55 mW - 200 mW = x20
<55 mW = x25

Suggested Frequencies:
Please remember this is a contest is focusing on rock-bound transmitters/transceivers.

80m	3560 kHz
	3568 kHz
40m	7030 kHz
	7040 kHz
20m	14060 kHz
15m	21060 kHz
10m	28060 kHz

Bonus Points:
For crystal controlled gear add 2,000 points for using rockbound receiver; add 3,000 points for using rockbound transmitter; or add 5,000 points for using rockbound transceiver. These bonus points are available per band.
If you are operating PORTABLE using battery power AND a temporary antenna, add 5000 points to your final score. (You can NOT be at your shack operating from battery power using your home station antenna to qualify for this bonus.) This is to help level the playing field for contesters who work from the field against contest stations with 5 element yagis at 70 ft.

Score:
Final Score = Points (total for all bands) x SPCs (total for all bands) x Power Multiplier + Bonus Points

Categories:
Entry may be All-Band, Single Band, High Bands (10m-15m-20m) or Low Bands (40m-80m)

How to Participate:
Get on any of the HF bands except the WARC bands and hang out near the QRP frequencies. Work as many stations calling CQ QRP or CQ TEST as possible, or call CQ QRP or CQ TEST yourself! You can work a station for credit once on each band.

Submissions:
Entries must be postmarked on or before 2 February 2010.

2010 QRP-ARCI Fireside SSB Sprint

Date/Time:
2000Z to 2359Z on 7 February 2010

Mode:
HF SSB only.

Exchange:
Members: RST, State/Province/Country, ARCI member #
Non-Members: RST, State/Province/Country, Power Out

QSO Points:
Member = 5 points
Non-Member, Different Continent = 4 points
Non-Member, Same Continent = 2 points

Multiplier:
SPC (State/Province/Country) total for all bands. The same station may be worked on multiple bands for QSO points and SPC credit.

Power Multiplier:
>10 watts = x1
>2 - 10 watts = x7
>500 mW - 2 watts = x10
>100 mW - 500 mW = x15
100 mW or less = x20

Suggested Frequencies:

80m	3985 kHz
40m	7285 kHz
20m	14285 kHz
15m	21385 kHz
10m	28385 kHz

Bonus Points:

If you are operating PORTABLE using battery power AND a temporary antenna, add 5000 points to your final score. (You can NOT be at your shack operating from battery power using your home station antenna to qualify for this bonus.) This is to help level the playing field for contesters who work from the field against contest stations with 5 element yagis at 70 ft.

Score:

Final Score = Points (total for all bands) x SPCs (total for all bands) x Power Multiplier + Bonus Points

Categories:

Entry may be All-Band, Single Band, High Bands (10m-15m-20m) or Low Bands (40m-80m)

How to Participate:

Get on any of the HF bands except the WARC bands and hang out near the QRP frequencies. Work as many stations calling CQ QRP or CQ TEST as possible, or call CQ QRP or CQ TEST yourself! You can work a station for credit once on each band.

Submissions:

Entries must be postmarked on or before 7 March 2010.

2010 QRP-ARCI HF Grid Square Sprint

Date/Time:

1500Z to 1800Z on 13 March 2009.

Mode:

HF CW only.

Exchange:

Members: RST, State/Province/Country, ARCI member #
Non-Members: RST, State/Province/Country, Power Out

QSO Points:

Member = 5 points
Non-Member, Different Continent = 4 points
Non-Member, Same Continent = 2 points

Multiplier:

SPC (State/Province/Country) total for all bands. The same station may be worked on multiple bands for QSO points and SPC credit.

Power Multiplier:

>5 watts = x1
>1 - 5 watts = x7
>250 mW - 1 watt = x10
>55 mW - 250 mW = x15
55 mW or less = x20

Suggested Frequencies:

160m	1810 kHz
80m	3560 kHz
40m	7030 kHz (please listen at 7040 kHz for rock bound participants)
20m	14060 kHz
15m	21060 kHz
10m	28060 kHz

Bonus Points:

If you are operating PORTABLE using battery power AND a temporary antenna, add 5000 points to your final score. (You can NOT be at your shack operating from battery power using your home station antenna to qualify for this bonus.) This is to help level the playing field for contesters who work from the field against contest stations with 5 element yagis at 70 ft.

Score:

Final Score = Points (total for all bands) x Grid Squares (total for all bands) x Power Multiplier + Bonus Points

Categories:

Entry may be All-Band, Single Band, High Bands (10m-15m-20m) or Low Bands (40m-80m)

How to Participate:

Get on any of the HF bands except the WARC bands and hang out near the QRP frequencies. Work as many stations calling CQ QRP or CQ TEST as possible, or call CQ QRP or CQ TEST yourself! You can work a station for credit once on each band.

Submissions:

Entries must be postmarked on or before 13 April 2010.

The QRP-ARCI Contest Championship

The QRP-ARCI Contest Champion-ship has been created in order to generate interest and participation among QRP operators in the contests sponsored by the QRP Amateur Radio Club International.

The QRP-ARCI Contest Champion-ship (QCC) is operated concurrently with the regular contest offerings of the QRP-ARCI. Each operator that enters any of the contests listed below is automatically entered in the QCC. Please submit your entries to the below contests, no matter how small they may seem.

ELIGIBLE CONTESTS: For 2010, the following ten contests sponsored by QRP-ARCI will be eligible for the QCC. All contests count equally.

- Pet Rock Celebration
- Winter Fireside SSB Sprint
- HF Grid Square Sprint
- Spring QSO Party
- Hootowl Sprint
- Summer Homebrew Sprint
- Silent Key Memorial Sprint
- VHF Contesta
- Fall QSO Party
- Holiday Spirits Homebrew Sprint

SCORING: Scoring for the QCC will be taken from the published results for each of the contests. The station placing first in each contest will receive a number of points equal to the average number of entrants in all of the QCC eligible contests from 2008. For the 2010 running of the QCC this number is 39. The station that places second will receive one less point, and so on, until either 1 point is reached, or the last entrant in the particular contest being scored is reached, whichever comes first. After that, zero points will be awarded for any additional entrants.

The final scores for the QCC will be the sum of the best six scores for each entrant. To be eligible for an award, an operator must enter at least three contests.

AWARDS: The person who is crowned as the QRP-ARCI Contest Championship Winner will be awarded a plaque suitable for hanging on their shack wall. Additional certificates will be awarded to the top scoring entrants in the championship.

QRP ARCI CONTEST ENTRY FORM

QRP ARCI CONTEST NAME: ______________________ MODE: ________

CALLSIGN: ______________ QTH: ______________ ARCI #: ______________

MULTIBAND or SINGLE BAND (please circle one) HIGHEST POWER USED: ________

SUMMARY TABLE

BAND	QSOs	POINTS	S/P/C
160m			
80m			
40m			
20m			
15m			
10m			
TOTAL			

Enter Points and S/P/C Per Band

Please total each column in the Summary Table

Score Calculation Formula uses Totals

Mail this form along with your log of contacts to:

Jeff Hetherington, VA3JFF
139 Elizabeth St. W.
Welland, Ontario
Canada L3C 4M3
or email to: contest@qrparci.org

TOTAL POINTS	X	TOTAL # S/P/C/	X	POWER MULTI	+	BONUS POINTS	=	FINAL SCORE
________	X	________	X	________	+	________	=	________

Total Operating Time: ______________

Transmitter / Transceiver ______________________________

Receiver ______________________________

Comments ______________________________

____

Name ______________________ CALL: ______________

Address ______________________________

City ______________________________

State/Province ______________________________

ZIP/Postal Code ______________________________

Country ______________________________

Email (In case of questions) ______________________________

QRP ARCI CONTEST LOG SHEET

ARCI CONTEST______________________ BAND _____ UR CALL ________

Time	Station	RST Out	RST In	His State	His#/Pwr	Workspace

Created by WB5KHC

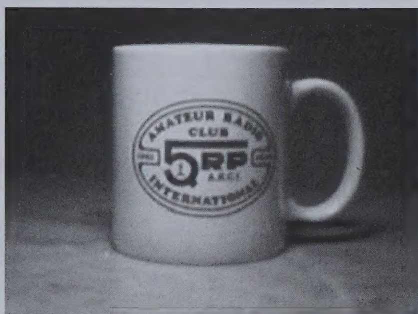
ARCI CONTEST____________________ BAND _____ UR CALL ________

1	2	3
4	5	6
7	8	9
0	DX	**Dupe Sheet** AMATEUR RADIO CLUB EST. 1961 QRP K6JSS A.R.C.I. INTERNATIONAL **Created by WB5KHC**

The

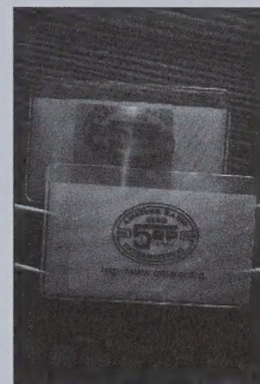
QRP-ARCI

Toy Store



The **Official** QRP-ARCI Coffee Mug. Used by the top QRP Fox Hunters, contesters and casual operators found near the normal QRP Frequencies.
The Logo is on both sides. Coffee, tea or milk not included.

The QRP-ARCI patches are fully stitched, black on white. 3 9/16" wide X 2 1/2" high oval. And they can either be ironed on, or sewn on the finest evening wear! Also available in Blue & Brass metal pins



Trouble reading those resistors? Plastic magnifiers for kit builders in a carrying case. Magnifiers $1.00 each

Polo Shirts with the logo above the pocket and **your** name and call. $30 postpaid (Add $2 for sizes XXL and above) Allow approximately 3-4 weeks for delivery Red, blue, green or white.

Also available—Key holders (2/$1), Pens (2/$1) all with the QRP-ARCI logo, and most back issues of the QRP Quarterly.

Orders to:
QRP-ARCI Toy Store
P.O. Box 41 Moodus, Ct 06469
Checks made out to QRP-ARCI
Or PayPal to
ToyStore@paypal.com

All prices Postpaid!

Patches $5 Coffee Mugs $10 Blue Logo Pins $7

25 Years of the QRP Quarterly
On CD or DVD
US members $29.95 Non Members $34.95
VE members $31.95 Non Members $36.95
DX members $34.95 Non Members $39.95
QRP-Quarterly 2006 on CD
US/VE members $10 Non Members $15
DX Members $15 Non Members @20

10 Years of FDIM(sm) (1996 - 2005) on CD................$18
Back issues of FDIM in print .... $8 each

The complete *Milliwatt* Newsletter on CD $11
How to Achieve 20 WPM CW $6
WITH NO EFFORT ON YOUR PART

CD Holders - hold 24 of your favorite QRP and Ham Radio CD's. Red, Blue or Black. $6

2nd Edition of the HW-8 Handbook..... $20
Covers the HW-7, 8 & 9 — Lots of new material!

See http://www.qrparci.org (QRP Toy Store link) for pictures

QRP ARCI STAFF

President
Ken Evans—W4DU
848 Valbrook Ct.
Lilburn, GA 30047
w4du@bellsouth.net

Vice President
Kathy Bromley—WQ5T
3424 Brooken Hill Dr.
Fort Smith, AR 72908
vp@qrparci.org

Treasurer, Membership/Subscriptions
Jack Nelson—K5FSE
1540 Stonehaven
Cumming, GA 30040
secretary@qrparci.org

Awards Manager
Jay Bromley—W5JAY
3424Brooken Hill Dr.
Fort Smith, AR 72908
jayw5jay@cox.net

Contest Manager
Jeff Hetherington—VA3JFF
139 Elizabeth Street West
Welland, ON L3C 4M3, CANADA
contest@qrparci.org

Webmaster
Steve Fletcher—G4GXL
43 Philip Rudd Court, Pott Row
Kings Lynn, Norfolk PE32 1WA, UK
webmaster@qrparci.org

BOARD OF DIRECTORS

Jay Bromley—W5JAY
3424Brooken Hill Dr.
Fort Smith, AR 72908
jayw5jay@cox.net

John Cumming—VE3JC
154 Guilford Crescent
London, ON N6J 3Y6, CANADA
jbcumming@sympatico.ca

Hank Kohl—K8DD
2130 Harrington Rd.,
Attica, MI 48412-9312
k8dd@arrl.net

Bill Kelsey—N8ET
3521 Spring Lake Dr.
Findlay, OH 45840
kanga@bright.net

Ed Hare—W1RFI
304 George Washington TPKE
Burlington, CT 06013
w1rfi@arrl.org

Steve Fletcher—G4GXL
43 Philip Rudd Court, Pott Row
Kings Lynn, Norfolk PE32 1WA, UK
webmaster@qrparci.org

Your membership lasts forever—but your subscription to *QRP Quarterly* must be renewed!

Go to the QRP ARCI web site and use the Online Member Lookup feature to keep track of your membership/subscription status:

http://www.qrparci.org/lookup.html

QRP ARCI takes membership applications and renewals via credit card—*online*—using the **PayPal** system. *We prefer it for all applicants—worldwide*! Go to the club web site:

http://www.qrparci.org/us2signup.html

and follow the instructions. Be sure to select the appropriate button for the area of the world you reside in (US, Canada, or DX). International members may send payment by check directly to the club Treasurer, but ... ***funds must be drawn on a U.S. bank and be in U.S. dollars.*** Make checks payable to: **QRP ARCI**.

When renewing, please enclose the mailing label from your *QRP Quarterly.* Send applications by mail to:

QRP ARCI
Jack Nelson, K5FSE
1540 Stonehaven
Cumming, GA 30040

Renew Now!
Don't Miss an issue of QRP Quarterly

Sign me up for a ❑ **NEW** / ❑ **RENEWAL** membership in QRP ARCI!

❑ **1 YEAR** ($20 US — US$23 Canada and Elsewhere)
❑ **2 YEARS** ($40 US — US$46 Canada and Elsewhere)

These amounts include active club member privileges and your QRP Quarterly subscription

Call ______________ QRP ARCI number (if renewal) ______________

Full Name ____________________________

Mailing Address ____________________________

City ______________ State/Country ______________

Postal Code (ZIP+4 US) ____________________________

Previous Callsign(s) if any ____________________________

(The following information is optional; used only by QRP ARCI; not released to others)

E-mail address ____________________________

Comments ____________________________

____

Send check or money order to: **QRP ARCI**
1540 Stonehaven
Cumming, GA 30040

QRP Quarterly (ISSN #1551-1537) is published quarterly in January ("Winter"), April ("Spring"), July ("Summer") and October ("Fall") by Summit Technical Media, LLC, 3 Hawk Drive, Bedford, NH 03110. Periodical postage paid at Manchester, NH and at additional mailing offices.

POSTMASTER: Send address corrections to QRP Quarterly, P.O. Box 10621, Bedford, NH 03110-0621. Subscription information: (603) 472-8261.

Subscription prices (all in U.S. dollars): Domestic one year $20, two years $40; Canada and elsewhere one year $23, two years $46.

QRP Quarterly is the official publication of the QRP Amateur Radio Club International (QRP ARCI), which is responsible for all editorial content. Editorial submissions should be sent to the Editor or an Associate Editor. See the staff listing on page 3 of each issue.

This magazine is published under agreement with QRP ARCI by Summit Technical Media, LLC — Business Office: PO Box 10621, Bedford, NH 03110-0621, tel: 603-472-8261, fax: 603-471-0716. Production and Advertising Office: 104 S. Grove Street, Mount Horeb, WI 53572; tel: 608-437-9800; fax: 608-437-9801.

United States Postal Service

Statement of Ownership, Management, and Circulation

1. Publication Title: QRP Quarterly
2. Publication Number: 1551-1537
3. Filing Date: 9/30/2009
4. Issue Frequency: Quarterly-Four times per year
5. Number of Issues Published Annually: Four
6. Annual Subscription Price: $20.00-USA; $23.00 Canada, and Elsewhere
7. Complete Mailing Address of Known Office of Publication *(Not printer) (Street, city, county, state, and ZIP+4)*: Summit Technical Media, LLC, 3 Hawk Drive, Bedford, NH 03110-4804
Contact Person: Scott L. Spencer
Telephone: 603 472 8261
8. Complete Mailing Address of Headquarters or General Business Office of Publisher *(Not printer)*: Summit Technical Media, LLC, 3 Hawk Drive, Bedford, NH 03110-4804
9. Full Names and Complete Mailing Addresses of Publisher, Editor, and Managing Editor *(Do not leave blank)*
Publisher *(Name and complete mailing address)*: Scott L. Spencer, PO Box 10621, Bedford, NH 03110
Editor *(Name and complete mailing address)*: Ted Bruce, 3625 Longfellow Trail, Marietta, GA 30062
Managing Editor *(Name and complete mailing address)*: Gary A. Breed, 104 S. Grove Street, Mount Horeb, WI 53572
10. Owner *(Do not leave blank. If the publication is owned by a corporation, give the name and address of the corporation immediately followed by the names and addresses of all stockholders owning or holding 1 percent or more of the total amount of stock. If not owned by a corporation, give the names and addresses of the individual owners. If owned by a partnership or other unincorporated firm, give its name and address as well as those of each individual owner. If the publication is published by a nonprofit organization, give its name and address.)*

Full Name	Complete Mailing Address
Summit Technical Media, LLC	PO Box 10621, Bedford, NH 03110
Scott L. Spencer	PO Box 10621, Bedford, NH 03110
Gary A. Breed	104 S. Grove Street, Mount Horeb, WI 53572

11. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities. If none, check box → ☒ None

Full Name	Complete Mailing Address

12. Tax Status *(For completion by nonprofit organizations authorized to mail at nonprofit rates) (Check one)*
The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes:
☒ Has Not Changed During Preceding 12 Months
☐ Has Changed During Preceding 12 Months *(Publisher must submit explanation of change with this statement)*

PS Form **3526**, October 1999 *(See Instructions on Reverse)*

13. Publication Title: QRP Quarterly
14. Issue Date for Circulation Data Below: Summer 2009

15. Extent and Nature of Circulation	Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date
a. Total Number of Copies *(Net press run)*	2063	2243
b. Paid and/or Requested Circulation (1) Paid/Requested Outside-County Mail Subscriptions Stated on Form 3541. *(Include advertiser's proof and exchange copies)*	1915	1955
(2) Paid In-County Subscriptions Stated on Form 3541 *(Include advertiser's proof and exchange copies)*	0	9
(3) Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Non-USPS Paid Distribution	75	75
(4) Other Classes Mailed Through the USPS	0	131
c. Total Paid and/or Requested Circulation *[Sum of 15b. (1), (2),(3),and (4)]*	1990	2170
d. Free Distribution by Mail *(Samples, compliment ary, and other free)* (1) Outside-County as Stated on Form 3541	0	0
(2) In-County as Stated on Form 3541	0	0
(3) Other Classes Mailed Through the USPS	18	18
e. Free Distribution Outside the Mail *(Carriers or other means)*	55	55
f. Total Free Distribution *(Sum of 15d. and 15e.)*	73	73
g. Total Distribution *(Sum of 15c. and 15f)*	2063	2243
h. Copies not Distributed	0	0
i. Total *(Sum of 15g. and h.)*	2063	2243
j. Percent Paid and/or Requested Circulation *(15c. divided by 15g. times 100)*	96%	97%

16. Publication of Statement of Ownership
☒ Publication required. Will be printed in the Fall 2009 issue of this publication. ☐ Publication not required.

17. Signature and Title of Editor, Publisher, Business Manager, or Owner: Scott L. Spencer, Publisher — Date: 9/30/2009

I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including civil penalties).